



**US Army Corps  
of Engineers**

Southwestern Division  
Tulsa District

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# PINE BLUFF ARSENAL

Site 38  
Impregnite Sludge  
Lagoon

**Site Closure Plan**

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JUNE 1985

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PINE BLUFF ARSENAL  
SITE 38  
IMPREGNITE SLUDGE LAGOON

SITE CLOSURE PLAN

DEPARTMENT OF THE ARMY  
TULSA DISTRICT, CORPS OF ENGINEERS  
TULSA, OKLAHOMA

June 1985

PINE BLUFF ARSENAL  
SITE 38  
IMPREGNITE SLUDGE LAGOON

SITE CLOSURE PLAN

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## SYNOPSIS

Site 38, Impregnite Sludge Lagoon at Pine Bluff Arsenal, Arkansas, will be closed in a FY 86 Military Construction, Army (MCA) project in accordance with all applicable State and Federal regulations. The general investigative procedures followed at Site 38 were to establish the extent and nature of contamination of waste materials both in the sludge and underlying soils. This included investigations sufficient in scope to determine the vertical and horizontal limits of contamination and to determine which contaminants would classify as hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). The contamination at this site consists of RCRA-listed organic compounds from the past use of Site 38 as a storage lagoon for laundry wastes from cleaning impregnite-treated clothing. Organic compounds detected in the lagoon sediments included chloroform, tetrachloroethane, naphthalene, 2-chloronaphthalene, DDE, etc (see section 3, table 3-2). Groundwater monitoring wells installed at Site 38 do not indicate contamination of groundwater; however, the presence of organics in the lagoon sludge and a perched water table in hydraulic connection with the lagoon provide the potential for contamination of the perched water. An off-site disposal plan which would require excavation and disposal of the contaminated sludge and soil (700 cubic yards) at the proposed hazardous waste landfill was investigated and is the proposed plan for closure at this site. This closure plan has an estimated cost of \$19,500 and is considered to be technically, economically and environmentally acceptable, based on the data presented in the following narrative.

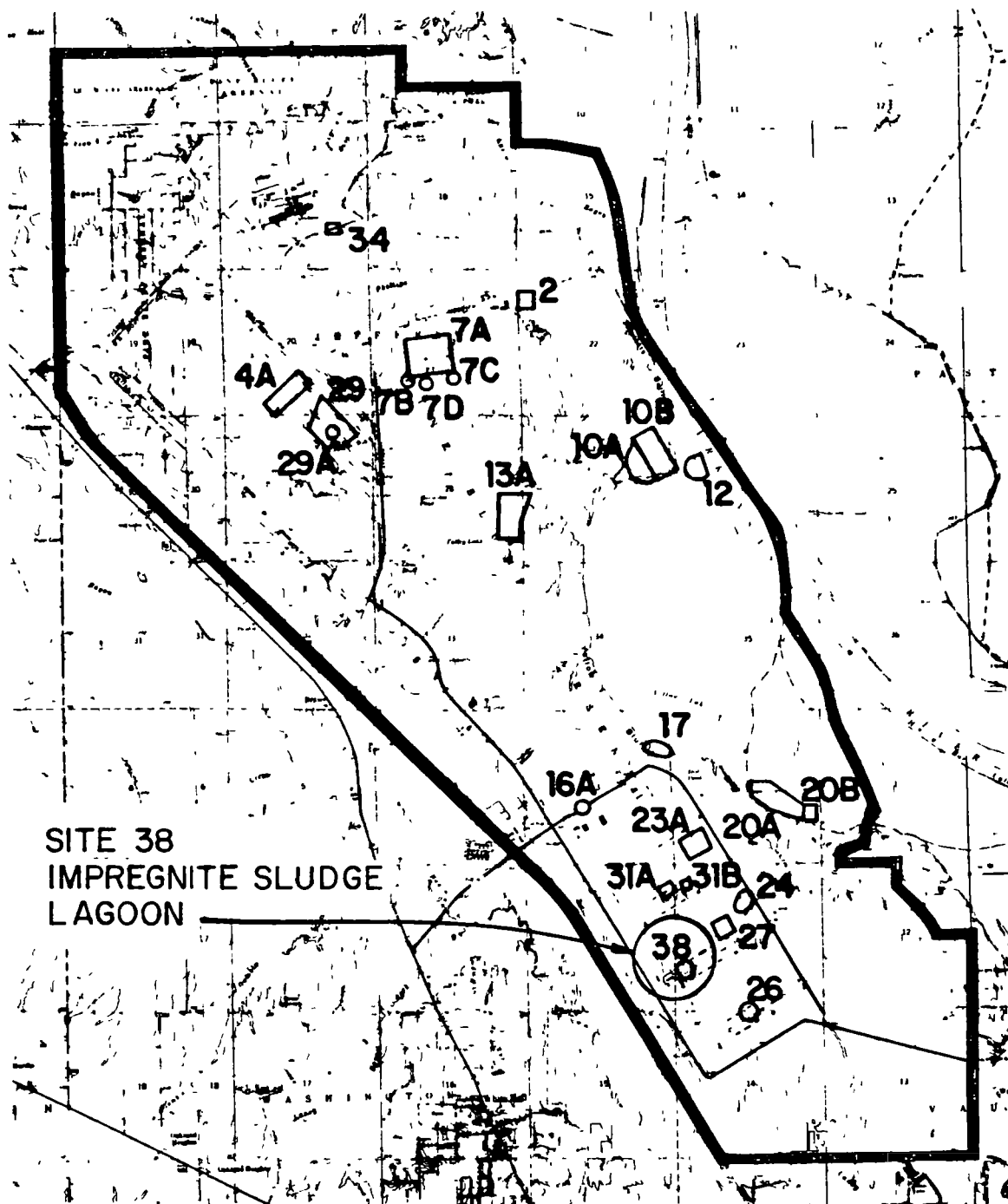
## I - GENERAL

1-01 Purpose. This report presents the closure plan for contaminated waste materials located at Site 38, the Impregnite Sludge Lagoon at Pine Bluff Arsenal, Arkansas. This site is an inactive site and will be permanently closed in accordance with applicable State and Federal regulations in order to eliminate an historical dump. Discussions between Arkansas Department of Pollution Control and Ecology (ADPCE), Tulsa District, Corps of Engineers (TDCE), and Pine Bluff Arsenal (PBA) personnel determined that remedial action must be conducted at this site in response to a ADPCE consent order issued to PBA. It was jointly decided to use a negotiation process between the parties similar to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Criteria for hazardous waste set forth in the Resource Conservation and Recovery Act (RCRA) were used to classify materials and manage waste which became subject to RCRA during the remedial action process. Cleanup limits for RCRA-listed metal contaminants were dictated by ADPCE and related to both Total Ion and EP Toxicity Testing (see section 3, table 3-1).

1-02 Report format. A site description is presented in Section 2. The geotechnical and contaminant investigations which form the basis for the proposed closure plan are contained in Section 3. A description of the proposed closure plan for this site is presented in Section 4. The indicated closure plan is considered to be the most technically feasible, cost effective, and environmentally acceptable alternative based on the results of geotechnical investigations and existing site conditions. An alternative closure plan and a cost comparison of estimates for both closure plans are presented in Sections 5 and 6, respectively.

## II - SITE DESCRIPTION

2-01. Site Description. Site 38, the Impregnite Sludge Lagoon, is a 50-foot square lagoon located just south of the water laboratory in the production area. The site is located in the southwest quadrant of the intersection of Avenue 321A and 321st Street as shown on Figure 2-1 and the aerial photograph in the Exhibit. The lagoon was designed in August 1974 and constructed shortly thereafter. It was used for the storage of laundry wastes from building 32-070 within which impregnite- treated clothing was cleaned. Impregnite is a chloramide compound which is fixed in clothing by a chlorinated paraffin binder. Wastes from the cleaning process were piped into the lagoon for 3 or 4 years. The lagoon has not been in use since that time. Rainfall accumulating over the normal 1-foot retention level and local runoff drains into a concrete overflow structure connected to an industrial sewer.



## PINE BLUFF ARSENAL

CLOSURE SITES

FIGURE 2 - 1

### III - GEOTECHNICAL AND CONTAMINANT INVESTIGATIONS

3-01. Introduction. The purpose of the exploration program was to (1) determine the location and properties of any clay strata beneath the site that would be acceptable for use as a lower impermeable boundary in an in-situ encapsulation scheme and (2) define the type, severity, and lateral and vertical extent of contamination.

3-02. Field Investigations. Seven auger holes ranging from 10 to 40 feet deep and one auger-denison hole 33 feet deep were drilled at Site 38 during the spring and summer of 1984 in locations shown on drawing 1. Soil from the auger holes was described in the field and classified in the laboratory. Each run with the auger was limited to 3 feet. To prevent mixing of materials or sampling material that had pulled off from the wall of the hole, only the interior portion of each sample was used. Material was taken from the entire 3-foot sample, sealed in plastic jars, and shipped to the Corps of Engineers Southwestern Division (SWD) Laboratory in Dallas. Soil from the auger-denison hole was also described in the field. The hole was drilled to a depth of 22.6 feet with an auger and an in-situ permeability test was run at this depth. Four denison tin samples were obtained below this to a total depth of 33.0 feet. The denison samples were sealed and shipped to the SWD laboratory for falling head permeability tests. Holes 6, 7, and 7A were backfilled with grout because they penetrated a clay stratum. In 1982, one upgradient and three downgradient monitoring wells were installed to monitor groundwater at the site. The boring for monitoring well 172 was drilled approximately 1,000 feet southwest of the lagoon and provided background chemical information for metals in soil at the Arsenal. The wells are regularly tested by the Army Environmental Hygiene Agency for selected parameters. The groundwater data from these wells is available on STORET, a computer system administered by the Environmental Protection Agency.

#### 3-03. Laboratory Testing.

##### a. Chemical Testing Procedures.

##### (1) Metals.

(a) Total ion testing. Soil samples were digested in strong acid and the resulting extracts were tested by atomic absorption spectroscopy techniques. The acid treatment resulted in total ion extraction, freeing the metals from the soil and pore water. A representative portion of the sample was oven dried and the values reported in milligrams/kilogram (mg/kg) dry weight. Tests were conducted for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver concentrations (the eight RCRA listed toxic heavy metal contaminants). In addition, zinc concentrations were determined because of its suspected presence at the site even though it is not a RCRA-listed contaminant. Groundwater samples were filtered in the lab and given a similar acid treatment. The results are reported in milligrams/liter (mg/l).

(b) EP toxicity testing. Extraction Procedure methodology, commonly referred to as EP toxicity testing, is a much less rigorous extraction of metals, designed to simulate typical leaching conditions in a landfill. Results are reported in mg/l (as a concentration in an extract obtained in a standard procedure). Because of the low total ion concentrations found in samples from Site 38, no EP toxicity testing was performed.

(2) Organics. Soil, sediment, and water samples were tested by gas chromatograph/mass spectroscopy (GC/MS) techniques. Selected samples were analyzed for purgeable organics, base/neutral extractable organic compounds, acid extractable organic compounds, and pesticides listed in the August 1980 EPA list of priority pollutants. Surface water samples were not filtered. Analyses were performed by Key Laboratory and Tek Continental Technical Services in Dallas, Texas, and results are presented in Appendix I.

b. Laboratory Soil Classification. Atterberg Limits, sieve analysis, and natural water content tests were performed on selected soil samples by the Corps of Engineers (SWD) Laboratory. The resulting classifications, based on the Unified Soil Classification System, were used to identify material types shown in the geologic sections presented on drawing 1. Monitoring well soil samples were also classified. Tests were performed at the Corps of Engineers Soils Laboratory at Tulsa. Tabulated results are presented as part of Appendix I. Laboratory visual classifications were used to verify field classifications.

c. Laboratory Permeability Test. Two falling head permeability tests were performed in the laboratory on specimens cut from undisturbed (denison) samples of the Jackson clay-shale. The tests were performed at the Corps of Engineers SWD Laboratory. The Jackson clay-shale was being investigated for effectiveness as a lower boundary in an encapsulation closure scheme.

### 3-04. Analysis.

a. Contamination Background Levels and Cleanup Limits - A consent agreement between the ADPCE and PBA is the basis for this remedial action. This agreement is based on Arkansas law which prohibits pollution of Arkansas waters but does not identify contaminants or allowable limits. Through discussions and letters, the ADPCE identified parameters and concentrations of concern as follows:

#### (1) Heavy Metals.

(a) Total ion concentration. The maximum contaminant level (MCL) for the 8 heavy metals listed in RCRA (40 CFR 261.24) were set at 10 times the background levels. "Arsenal-wide" background levels were calculated as the mean of 102 samples collected at uncontaminated areas near 17 of the sites.

(b) EP toxicity concentrations. In addition to meeting the MCL for the total ion method, the ADPCE also required that the samples not exceed one-tenth the regulatory values shown in RCRA (40 CFR 261.24) when analyzed using EP methodology. Table 3-1 lists background levels and MCL's (cleanup limits) for these heavy metals.

TABLE 3-1

HEAVY METAL BACKGROUND LEVELS AND  
CLEANUP LIMITS

Contaminant	Background Mean (mg/kg)	Site Cleanup Limits	
		Total Ion MCL (mg/kg)	EP Toxicity MCL (mg/l)
Arsenic (As)	1.30	13.0	0.50
Barium (Ba)	28.70	290.0	10.00
Cadmium (Cd)	< 0.50	5.0	0.10
Chromium (Cr)	< 5.00	50.0	0.50
Lead (Pb)	7.55	75.5	0.50
Mercury (Hg)	< 0.10	1.0	0.02
Selenium (Se)	0.18	1.8	0.10
Silver (Ag)	< 0.50	5.0	0.50
Zinc (Zn) (1)	8.50	1/	1/

1/ Background level for zinc was determined since it is a common constituent of demilitarized ordnance wastes. Zinc is not a RCRA-listed contaminant; therefore, cleanup limits were not required by ADPCE.

(2) Organics - A GC-mass-spectrometer scan was conducted on samples from those sites where there is evidence of disposal of organic compounds. At those sites where the tests revealed the presence of compounds listed in RCRA (40 CFR 261.33), an individual determination of the substance hazard was made. This was dependent on the compounds and the amount present in the sample. This determination was used to develop the recommended closure plan and is subject to approval of the ADPCE. No testing for the organic compounds found at the sites was performed on the soil samples from the background holes. The organics of primary concern are not naturally occurring and should not be present in background soil samples.

b. Determining Extent of Metal Contamination. Samples from hole 38-5 were tested for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and zinc. No RCRA listed metals were found to be present in high concentrations so EP toxicity tests were not performed. Results of chemical testing for metals are plotted with depth and compared to cleanup limits for each boring in the boring contaminant plots (Appendix II.) With the results plotted in this manner, the extent of heavy metal contamination, if any were present, could be easily determined.

c. Metal Contamination Results.

(1) EP Toxicity Testing. No EP Toxicity Tests were performed at this site due to the low levels of metal contaminants found during Total Ion Testing.



(2) Fill and Underlying Soil. Test results from hole 38-5 in the center of the lagoon and two sediment samples indicate that the sludge and underlying soil does not contain any detectable silver, chromium, mercury, or selenium. Cadmium was found in the sediment ranging from 1.8 to 3.9 mg/kg but was not detected in natural soil. Arsenic, barium, and lead were detected in very low concentrations in the 5 feet of fill material (2 mg/kg As, 34 mg/kg Ba, and 13 mg/kg Pb), but were not present in the underlying soil. Only zinc, a non-RCRA toxic contaminant, was detected in high concentrations (18,000 mg/kg in the sludge and 520 mg/kg in the soil). The fill and underlying soil are not, therefore, contaminated with metals exceeding the established cleanup limits (see table 3-1).

(3) Soil Surrounding the Lagoon. Test results from all of the borings in the soil surrounding the lagoon indicated only background levels of RCRA-listed metals. Only zinc was found in the surrounding soil with concentrations ranging from 200 mg/kg throughout the upper 2-foot layers to 10-30 mg/kg in deeper soil layers. Since zinc is not a RCRA-listed contaminant and does not have an established cleanup limit, the soil surrounding the lagoon is not contaminated with metals exceeding the established cleanup limits (see table 3-1).

(4) Lagoon water. One sample of lagoon water was analyzed for all 8 RCRA-listed metals, zinc, and organics (purgeable, base neutral extractable, and acid extractable). Lead was present in a concentration of 0.11 mg/l and zinc was present in a concentration of 80 mg/l. Lead concentrations exceed the primary drinking water quality standard of 0.05 mg/l and zinc exceeds the secondard drinking water quality standard of 5.0 mg/l. No other metals were present in detectable quantities. Methylene chloride was detected at a concentration of 1.16 mg/l.

d. Determining Extent of Organic Contamination. One sediment and one water sample from Site 38 were analyzed for purgeable organics, base/neutral extractable organics, acid extractable organics, and pesticides listed on the August 1980 EPA list of priority pollutants. Seventeen compounds were detected in the sediment and water samples tested and are presented in table 3-2. Four of these compounds (chloroform, tetra-chloroethylene, 2-Chloro-naphthalene and DDE) were chosen for further analysis in the soil because of their high concentrations in the lagoon sediments. Those compounds with a specific gravity greater than one (1) would be expected to sink in water to an impermeable layer and those with a specific gravity less than one (1) would be expected to rise to the surface of the pond or the phreatic surface (figure 3-1). All holes were sampled and analyzed for the 4 organics to determine the depth and migration of organic contamination. Holes 38-1 through 38-5 were drilled 9.5 to 10 feet in depth and were analyzed for the most prevalent compounds. Saturated soil samples from holes 38-6 and 38-7 were analyzed for these compounds at three locations as shown in figure 3-1; (1) at the top of the perched water table (8 to 10 feet in depth), (2) just above the Jackson clay-shale layer (16 to 19.5 feet in depth), and (3) at the top of the permanent water table (35 to 37 feet in depth).

TABLE 3-2  
RESULTS OF WATER/SEDIMENT ORGANIC ANALYSES  
SITE 38

Compound	Sample 1/	Minimum Level Detectable	Concentration in Sample	Specific Gravity
<u>Acid Extractable Compounds</u>				
Phenol	WS	0.02 mg/l	0.13 mg/l	
<u>Volatile Compounds</u>				
Benzene	SD-3	0.002 mg/kg	0.009 mg/kg	.88
Carbon Tetrachloride	SD-3	0.003 mg/kg	3.19 mg/kg	1.58
Chloroethane	SD-3	0.009 mg/kg	0.015 mg/kg	
Chloroform	SD-3	0.005 mg/kg	20.6 mg/kg	1.49
1,2-Dichloroethane	SD-3	0.006 mg/kg	0.028 mg/kg	1.26
Methylene Chloride	SD-3	0.004 mg/kg	3.52 mg/kg	
Methylene Chloride	WS		1.16 mg/l	
1,1,2,2-Tetra chloroethane	SD-3	0.004mg/kg	0.691 mg/kg	
Tetrachloroethane	SD-3	0.006 mg/kg	21.3 mg/kg	1.60
Toluene	SD-3	0.002 mg/kg	0.112 mg/kg	.86
1,1,1-Trichloroethane	SD-3	0.003 mg/kg	0.080 mg/kg	1.35
Trichloroethylene	SD-3	0.006 mg/kg	0.050 mg/kg	1.35
Vinyl Chloride	SD-3	0.006 mg/kg	0.14 mg/kg	
<u>Base/Neutral Extractable Compounds</u>				
2-Chloronapthalene	SD-3	1.5 mg/kg	28.5 mg/kg	
Di-n-Butyl Phthalate	SD-3	0.5 mg/kg	6.65 mg/kg	
Naphthalene	SD-3	1.0 mg/kg	16.3 mg/kg	1.15
<u>Pesticide Compounds</u>				
4,4-DDE	SD-3	2.0 mg/kg	72.0 mg/kg	

1/ WS = water; SD = sediment

# TYPICAL SUBSURFACE PROFILE

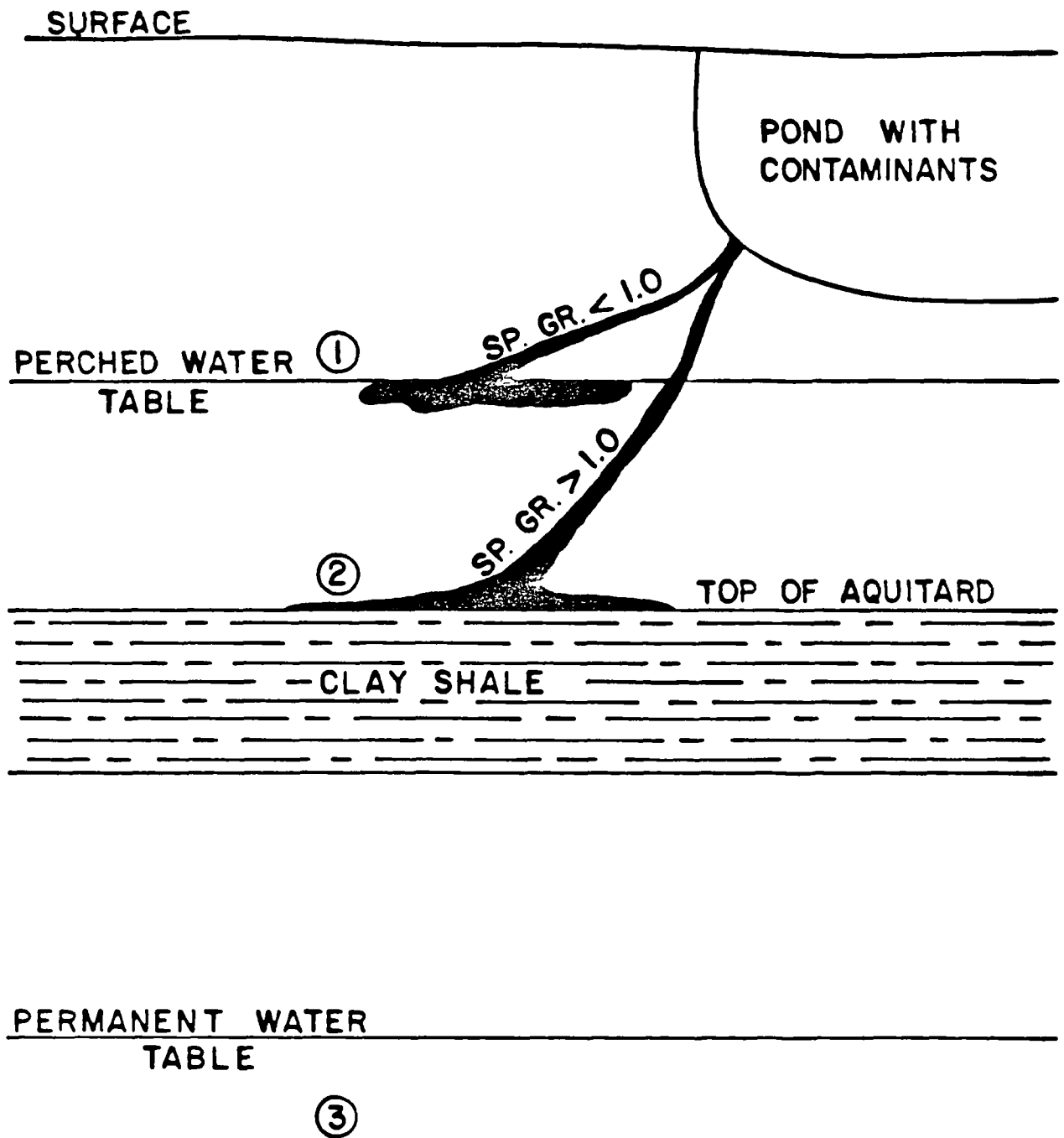


FIGURE 3-1

e. Results of Organic Contamination. Results of the investigations on the soil are presented in table 3-3. The amounts of these compounds detected in the soil are very minute and of no environmental hazard. The water in the lagoon had only a small amount of phenol (0.13 mg/l) when analyzed for organic compounds. The only material contaminated with organics is the sludge in the lagoon. In the case of the one sample of soil from hole 38-6 showing a high quantity of chloroform (19 mg/l at 8 to 10 feet in depth), additional testing of the samples above and below that sample was performed and confirm that this contamination is isolated to this one area. Based on these results, significant organic contamination is limited to the lagoon sludge. Therefore, approximately 500 cubic yards of contaminated material exists at this site, including a 12-inch depth of stripping beneath the sludge. See section 4 for expanded closure plan quantities.

f. Groundwater Contamination. Groundwater encountered at Site 38 belongs to the Jackson/Quaternary aquifer. This aquifer generally yields small amounts of low quality water and is not used for any water supply purpose in the vicinity of the arsenal. Drinking water in the area is supplied from the sparta sand which is about 600 feet below the site and is separated from it by low permeability Jackson and upper Claiborne groups. Tests have been performed on groundwater samples from the 4 monitoring wells over a period of two years. Three of the wells, two downgradient (169 and 170) and one upgradient (172), are set in the permanent water table. Well 171 (downgradient) was set in the perched water table. Barium was detected at or just above the detectable limit (0.1 mg/l) in several of the sampling periods in both upgradient and downgradient wells. Arsenic was found in low concentrations (.014-.0289 mg/l) in the upgradient well but not in any of the downgradient wells. Total organic carbon averaged 58 mg/l in upgradient well 172 and less than 30 mg/l in all 3 downgradient wells. Perched water contaminant levels did not differ significantly from those in the permanent water table. Total organic halogen averaged between 0.052 and 0.063 mg/l for all four wells. Based on these results of the groundwater monitoring wells, and the absence of metal or organic contaminants in the soil below and around the pond, it is concluded that Site 38 is not contributing to contamination of the permanent water table. Because of the presence of organics in the pond sediments, and the hydraulic connection of the pond water and perched water, the potential for contamination of the perched water exists at the site.

### 3-05. Stratigraphic Results.

a. General. Site 38 is situated on terrace deposits approximately 20 feet thick. These deposits are unconsolidated sands, silts, and clays resting on the Jackson Group. The Jackson consists of high plasticity clay-shale in excess of 30 feet in thickness. The location of this site is shown in figure 3-2 on a map of geologic environments at PBA. Fill material is about 5 feet thick within the limits of the lagoon.

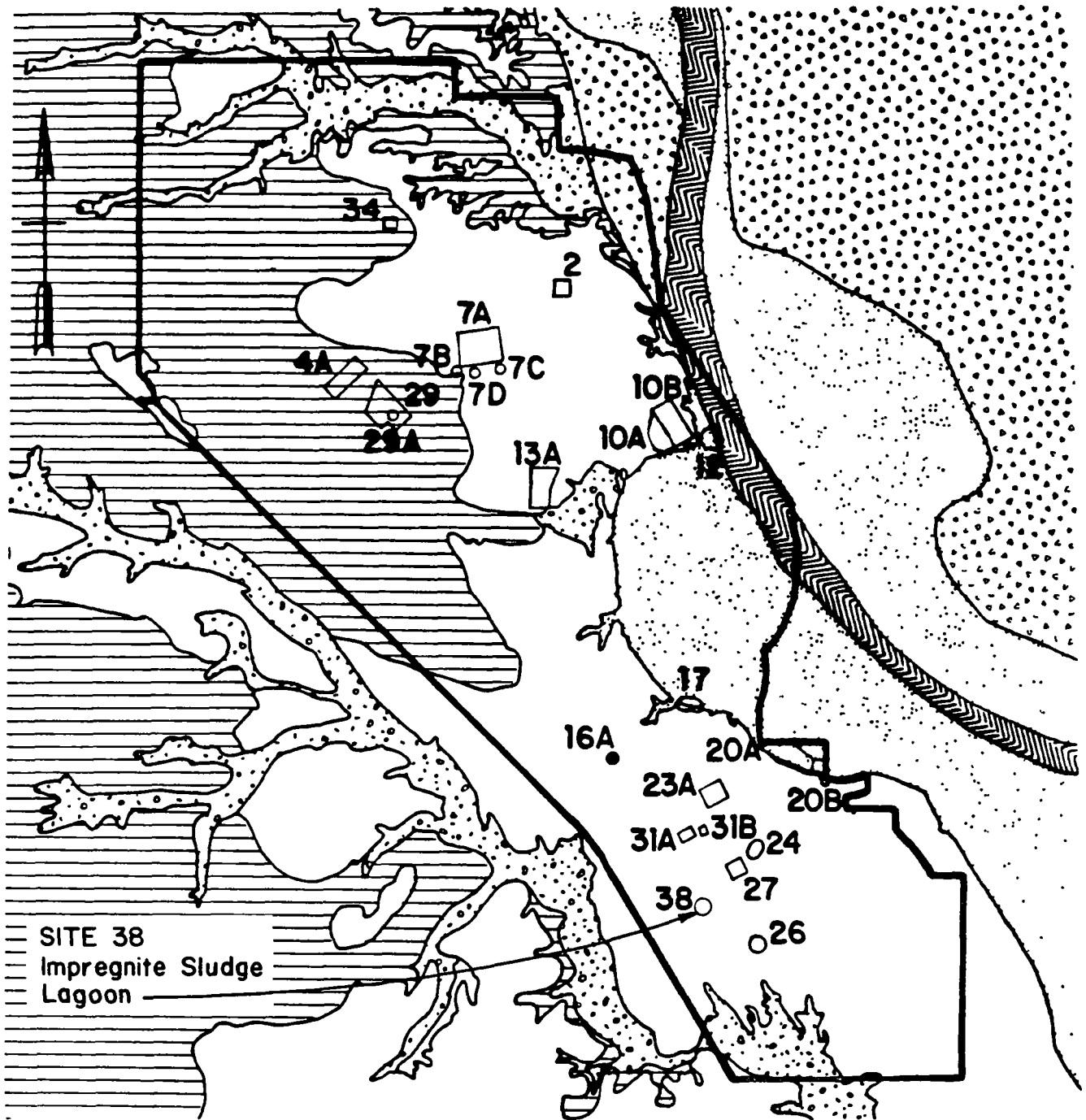
b. Jackson Group. A geologic cross section is presented in drawing 1. The uppermost bed of the Jackson at the site is a clay-shale. Depths to the strata range from 19.5 feet at hole 38-6 to 24 feet at monitoring well 169. The upper 10 feet of the clay-shale is low to medium

TABLE 3-3

RESULTS OF SOIL ORGANIC ANALYSES  
 SITE 38  
 (Results in mg/kg)

Hole	Jar	Depth	Chloroform	Tetrachloro- ethylene	2-Chloro- napthalene	P,P DDT	P,P DDD	P,P DDE
1	J-1	0.0-1.0'	0.25	< 0.0003	< 0.05	< 0.01	< 0.008	< 0.006
1	J-3	2.0-3.0'	0.12	0.006	0.26	< 0.01	< 0.008	< 0.006
1	J-6	7.0-10.0'	0.03	0.008	1.3	< 0.01	< 0.008	< 0.006
2	J-1	0.0-1.0'	0.12	0.007	0.23	< 0.01	< 0.008	< 0.006
2	J-4	3.0-5.0'	0.10	0.006	0.73	< 0.01	< 0.008	< 0.006
2	J-7	7.0-10.0'	0.11	0.007	0.96	< 0.01	< 0.008	< 0.006
3	J-1	0.0-1.0'	0.10	0.004	0.52	< 0.01	< 0.008	< 0.006
3	J-5	3.5-5.5'	< 0.001	0.004	0.37	< 0.01	< 0.008	< 0.006
3	J-9	8.5-10.0'	0.11	0.003	0.26	< 0.01	< 0.008	< 0.006
4	J-1	0.0-1.0'	0.09	0.004	0.40	< 0.01	< 0.008	< 0.006
4	J-3	2.0-3.0'	0.15	0.004	0.26	< 0.01	< 0.008	< 0.006
4	J-6	7.0-10.0'	0.10	0.005	0.39	< 0.01	< 0.008	< 0.006
5	J-3	5.2-6.2'	-	-	0.29			
5	J-6	8.5-9.5'	-	-	< 0.18	< 0.04	< 0.03	< 0.02
6	J-3		.36-.56					
6	J-4	7.5-10.5'	19.0	1.0	< 2.0	-	-	< 0.01
6	J-5		.92-1.00					
6	J-7	16.5-19.5'	0.7	1.1	< 2.0	-	-	< 0.01
6	J-13	35.0-37.0'	1.0	0.9	< 2.0	-	-	< 0.01
7	J-5	9.5-12.5'	0.8	0.2	< 2.0	-	-	< 0.01
7	J-7	16.0-19.0'	0.3	0.3	< 2.0	-	-	< 0.01
7	J-8	19.0-22.0'	1.0	0.2	< 2.0	-	-	< 0.01
7	J-14	36.0-39.0'	0.4	0.2	< 2.0	-	-	< 0.01

plasticity with the plasticity increasing with depth. In-situ permeability test results, at a depth of 22.6 feet, was  $3 \times 10^{-8}$  cm/sec. Falling head permeability tests were performed at the SWD Laboratory on two samples. At a depth of 23.0 to 25.0 feet the permeability was found to be  $2.1 \times 10^{-8}$  cm/sec and at 28.0 to 30.0 feet, the permeability was found to be  $1.6 \times 10^{-7}$  cm/sec. The 30-foot thickness and relative impermeability of the clay shale make it an excellent stratum for use in an insitu encapsulation scheme.



**ARKANSAS RIVER  
ARKANSAS RIVER  
DEPOSITS**



**TERRACE  
BACKSWAMP  
ALLUVIUM**



**RECENT ALLUVIUM  
JACKSON GROUP**

## GEOLOGIC ENVIRONMENTS

SCALE IN FEET  
2000 0 2000 4000

FIGURE 3-2

#### IV - CLOSURE PLAN

4-01. General. The proposed closure plan for Site 38 is to dewater the lagoon, excavate and remove the contaminated material to the hazardous waste landfill, and regrade the site (see figures 4-1 and 4-2) since this plan is more cost effective than on-site closure. During the project's concept design phase, which was completed in August 1984, in-situ encapsulation of this site's contaminated material was recommended since detailed organic analysis of the lagoon sediments and underlying soils had not yet been completed. The results of these analyses have indicated that organic contamination at this site is limited and suitable for landfill disposal. However, the presence of these RCRA-listed organics classifies the contaminated material as a RCRA hazardous waste upon their excavation. Consequently, this material must be disposed in a RCRA-approved landfill facility. The proposed closure plan would be accomplished as described below.

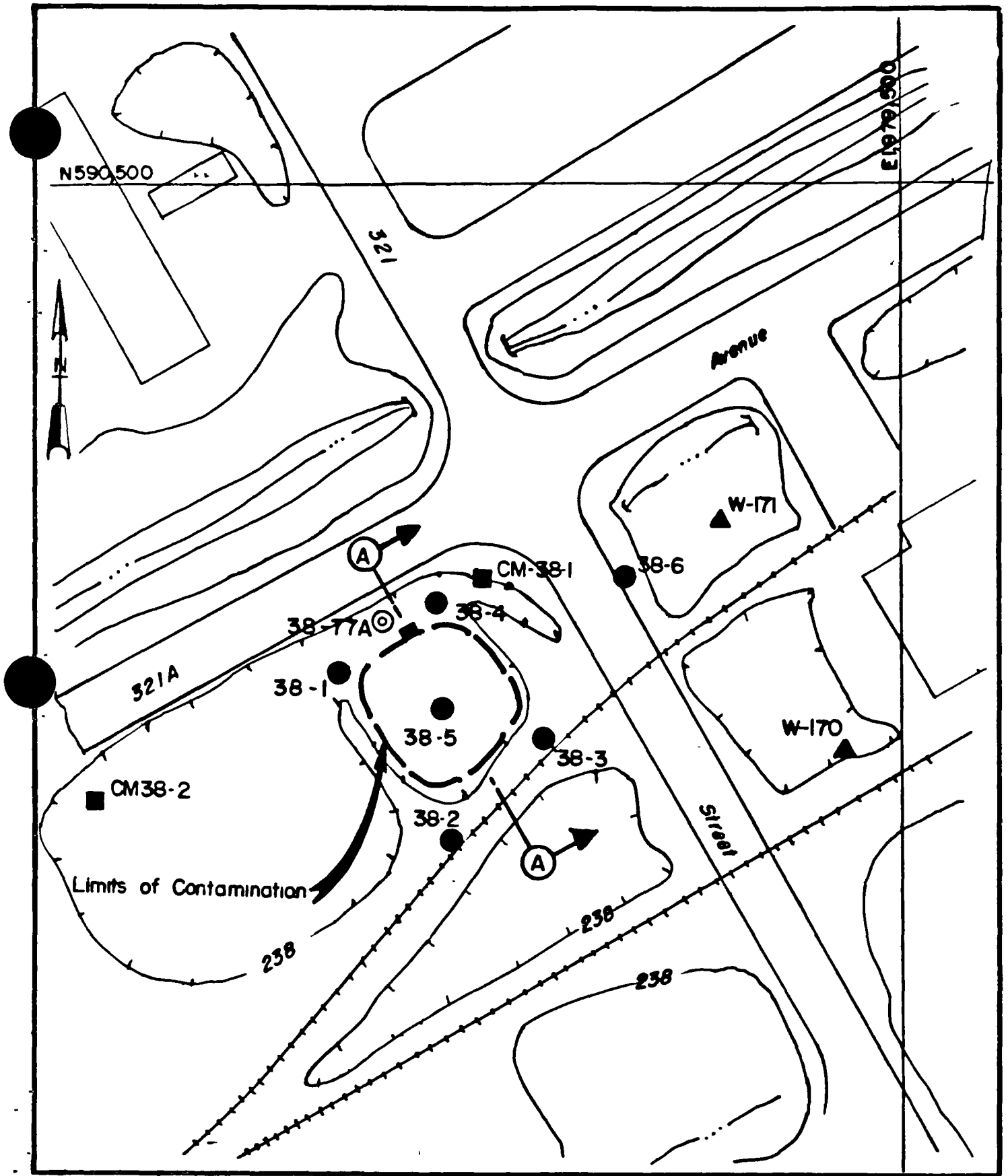
4-02. Lagoon dewatering. The lagoon on Site 38 would be dewatered first by pumping it into an adjacent concrete overflow structure which flows into an industrial sewerline. The sewer would transport the lagoon water to the industrial waste treatment facility for treatment.

4-03. Contaminated material movement. Once the lagoon has been dewatered, all sludge, including 12 inches of underlying soil, would be stripped and hauled about 10 miles to the hazardous waste landfill. Approximately 500 cubic yards of contaminated material is present at the site; however, this closure plan has been based on 700 cubic yards of material which allows for 15% overexcavation during construction and a 20% volume increase to reflect the bulking which occurs during excavation and recompaction. It should be noted that the disturbance and handling of these sediments to accomplish contaminated material disposal would classify this portion of the contaminants at Site 38 as a RCRA hazardous waste. A temporary washrack facility would be constructed at the site to allow washdown of hauling vehicles prior to their leaving the site area. Construction equipment would also be washed prior to handling clean fill/earth, and prior to transportation off-site. Washwater would be collected in a holding pond and pumped into a nearby industrial sewer manhole for treatment and disposal at the Arsenal's industrial waste treatment facilities.

4-04. Regrading. Once the contaminated material is removed, the lagoon berm and overflow structure would be dozed into the excavated lagoon area along with additional compacted random fill to bring the area to existing natural contours allowing positive drainage off the site. All areas disturbed during closure would be covered with 6 inches of topsoil, tilled, fertilized, and seeded.

4-05. Operation and maintenance. Site 38 will remain closed. Some maintenance would be required for approximately 2 years to protect against erosion until vegetation growth is firmly established. Then the site would be mowed in accordance with the PBA's existing mowing schedule. No groundwater monitoring or other post closure care would be required since the source of potential groundwater contamination would be removed.

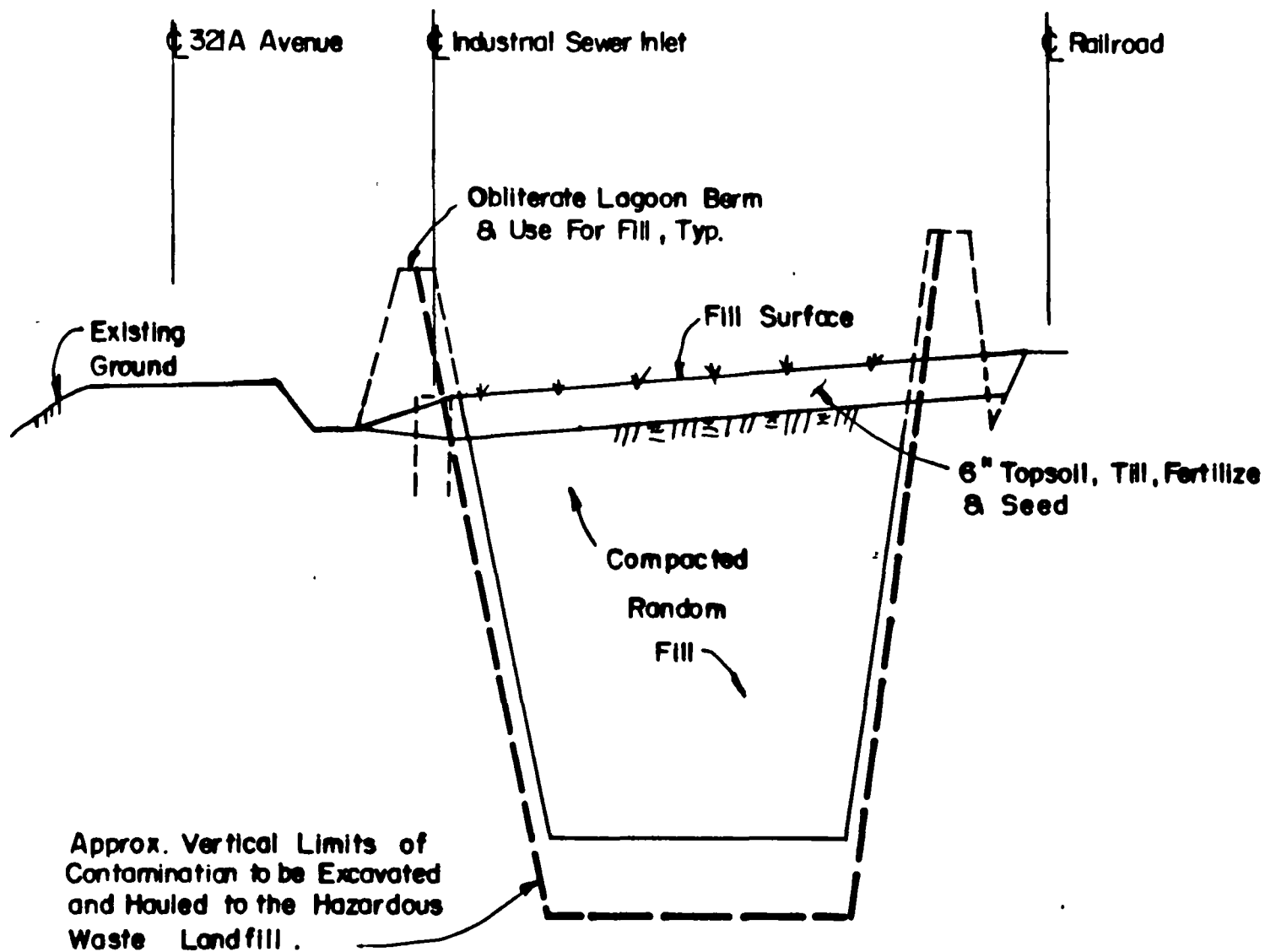




# SITE 38 CLOSURE PLAN

NO SCALE

**SITE 38**  
**CLOSURE SECTION A-A**  
**NO SCALE**



## V - ALTERNATIVE CLOSURE PLAN

5-01. General. The clay-shale layer discussed in Section 3 forms the basis for the alternative closure plan of in-situ encapsulation. It would be utilized as the lower boundary of a closure cell. A slurry wall keyed into the clay layer and covered with a clay cap would be constructed around the lagoon. This alternative closure plan was developed to confirm the economic feasibility of the recommended closure plan (see figure 5-1).

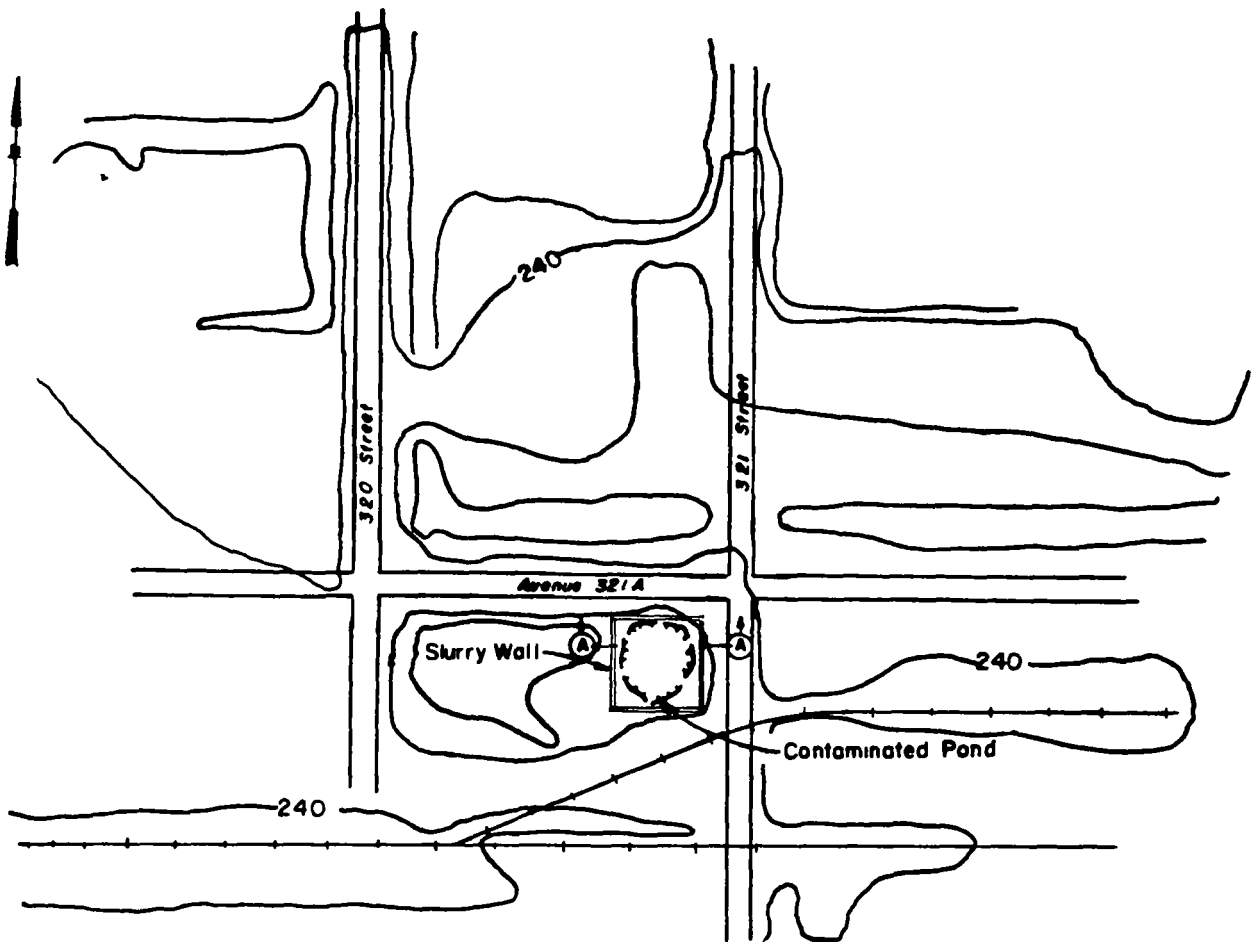
5-02. Construction. Construction of this closure cell would be accomplished as follows:

a. Dewatering. The lagoon would be dewatered as described in paragraph 4-02.

b. Closure cell. Once the lagoon has been dewatered, its berms would be dozed into the lagoon along with additional compacted low-permeability fill to bring the pond area to existing natural contours allowing positive drainage off the site. The slurry wall would then be constructed around the site forming the cell sides. The wall would be keyed a minimum of 2 feet into the clay-shale which forms the cell bottom about 22 feet beneath the site.

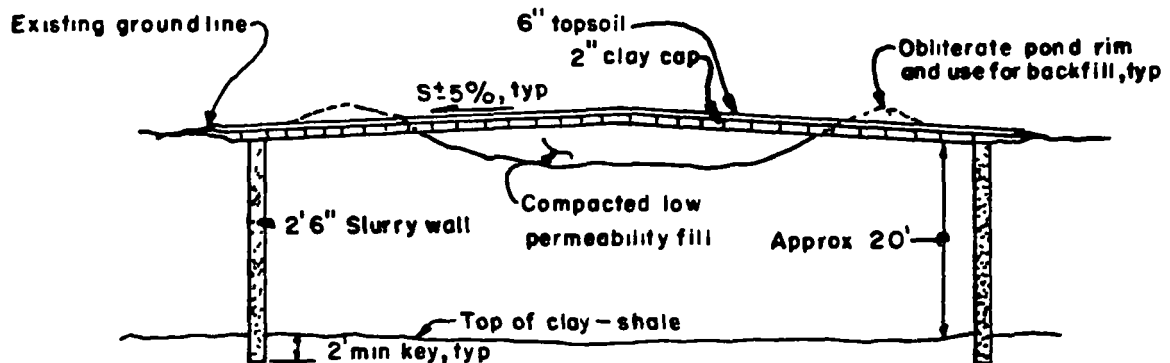
c. Cover and grading. Once all backfill has been placed within the cell and graded to provide a positive slope for drainage away from the cell, the cell would be capped with a 2-foot thick clay cover which would extend beyond the slurry wall to prevent vertical migration of contaminants and to provide run-on control. The entire disturbed area of the site and the closure cell would be covered with 6 inches of topsoil and revegetated.

d. Operation and Maintenance. Requirements would be similar to those discussed for the recommended closure plan except that groundwater monitoring would be required throughout the post-closure period. A minimum of four wells would be required with semi-annual testing and reporting to appropriate regulatory agencies.



# PLAN

SCALE OF FEET



# SECTION A-A

NO SCALE

## SITE 38 ALTERNATIVE PLAN OF CLOSURE

FIGURE 5-1

## VI - COSTS

6-01. General. Unit prices are based on average bid prices for similar type projects constructed or under construction in the Tulsa District and adjusted to January 1987 price levels.

a. Contaminated material movement. Costs for transporting all contaminated materials include costs of excavation, hauling, placement, and compaction of materials into the hazardous waste landfill.

b. Borrow availability. It was assumed that all random fill and topsoil would be supplied from approved borrow sources located on arsenal property and a 10-mile haul distance was assumed to the site for unit cost purposes. Detailed borrow area investigations would be conducted during the final design to confirm the availability of random fill and top soil in sufficient quantities within a 10-mile haul distance.

c. Dewatering. Lagoon dewatering costs assume direct pumping of water of the lagoon into the adjacent industrial sewer inlet.

6-02 Estimated Costs. A comparison of estimated costs for the proposed and alternative closure plans are shown in table 6-1 which indicates a \$19,200 savings for the alternative on-site closure plan. Operation and maintenance costs for the alternative plan are significantly higher (\$8,000/year); however, due to the requirement for maintenance and semi-annual testing of the four groundwater monitoring wells. Based on a 30-year post-closure monitoring period utilizing a discount rate of 10 percent, the life cycle cost resulting from groundwater well maintenance, sampling, and testing totals \$75,200. This cost does not include O&M cost escalation which would occur during the 30-year monitoring period. Thus a comparison of life cycle costs (table 6-2) indicates that the proposed closure plan is more cost effective by \$56,000.

TABLE 6-1

ESTIMATED CAPITAL COSTS

Item	Proposed Closure Plan (Landfill)	Alternative Closure Plan (On-Site)
Site Preparation	360	360
Closure Cell Earthwork	7,600	5,200
Contaminated Material Movement (700 CY)	8,600	-
Groundwater Monitoring Wells (2)	-	12,000
Slurry Trench	-	29,000
Site Grading and Revegetation	<u>1,100</u>	<u>1,100</u>
Subtotal	17,660	47,660
Contingencies @ 5% <u>+</u>	840	2,340
Subtotal	18,500	50,000
Supervision and Inspection @ 5.5% <u>+</u>	<u>1,000</u>	<u>2,800</u>
TOTAL	19,500 <u>1/</u>	52,800

1/ Prorata Landfill Capacity Cost (700 CY) = \$52,500; therefore, total capital cost of proposed closure plan = \$72,000.

TABLE 6-2

LIFE CYCLE COSTS

Item	Proposed Closure Plan (Landfill)	Alternative Closure Plan (On-Site)
Capital Cost (incl Prorata LF Cost)	72,000	52,800
Groundwater Monitoring	-	<u>75,200</u> <sup>1/</sup>
Total Life Cycle Cost	72,000	128,000

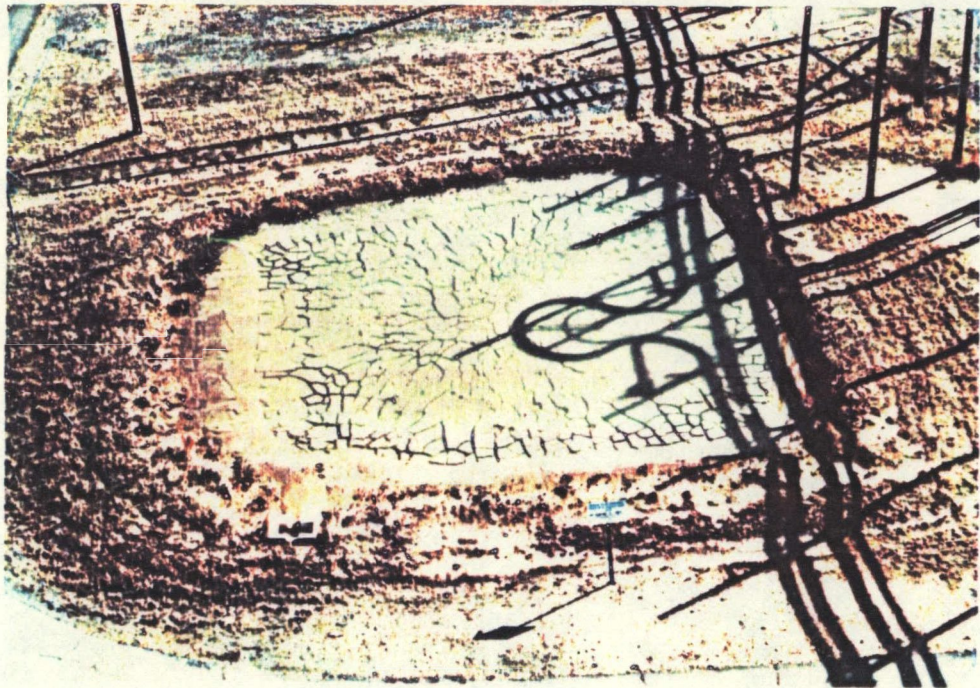
<sup>1/</sup> Life Cycle (present worth) factor = 9.40 for annual cost of \$8,000 @ 10% discount rate for 30-year life (post closure period).

EXHIBIT



EXHIBIT A

SITE PHOTOGRAPH



View looking Southeast at lagoon. Intersection of Avenue 321A and 321st Street shown in lower left corner of photograph. Note inlet to industrial sewer in the lower left corner of the lagoon.

# APPENDICES

APPENDIX I

LABORATORY, CHEMISTRY AND SOIL REPORTS

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
**4815 Cass Street**  
**Dallas, Texas 75235**

**SUBMITTAL OF SWDED-GL REPORT 13759 ( 3 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 26 March 1984  
**Received:**

**From:** Chief  
Geotechnical Branch  
Tulsa District

**MATERIAL:** Soil and water  
**No. and type of samples:** 2 soil and 1 water samples  
**Source or other identification:** 38-SD-1, 38-SD-2 and 38-WS-1

**Date received:** 28 March 1984

**REMARKS:**

Results of Chemical Analysis of Soil  
Results of Chemical Analysis of Water

Table 1  
Table 2

**Report sent to:**

Tulsa District

**Copy furnished:**

**Date:**

5 May 1984

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



Results of Chemical Analysis of Soil<sup>(1)</sup>

<u>SWD Lab No</u>	<u>Site Hole</u>	<u>Jar No.</u>	<u>Depth</u>	<u>Ag</u>	<u>As</u>	<u>Ba</u>	<u>Cd</u>	<u>Cr</u>	<u>Hg</u>	<u>Pb</u>	<u>Se</u>	<u>Zn</u>
5794		SD-1	(North)	<0.5	<1.0	< 20	3.9	<5.0	< 0.1	<1.0	< 0.1	22,000
5795		SD-2	.(South)	<0.5	<1.0	26	1.8	<5.0	< 0.1	< 1.0	< 0.1	25,000

Minimum reported concentration    0.5       1.0       20.0    0.5    5.0       0.1       1.0       0.1       1.0

(1) Results reported in mg/kg.

Results of Chemical Analysis of Water<sup>(1)</sup>

<u>SWD</u> <u>Lab No</u>	<u>Site</u> <u>Hole</u>	<u>Field</u> <u>No.</u>	<u>Depth</u>	<u>Ag</u>	<u>As</u>	<u>Ba</u>	<u>Cd</u>	<u>Cr</u>	<u>Hg</u>	<u>Pb</u>	<u>Sr</u>	<u>Zn</u>	<u>Li</u>
5793	38	WS-1	Unknown	<0.01	<0.001	<0.5	0.0005	<0.01	<0.0001	0.11	0.0004	80.0	

Minimum reported concentration	0.01	0.001	0.5	0.002	0.01	0.0001	0.01	0.0004	0.01
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(1) Results reported in mg/l.

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

**SUBMITTAL OF SWDED-GL REPORT 13759-1 ( 2 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 16 April 84  
**Received:**

**From:** Chief  
Geotechnical Branch  
Tulsa District

**MATERIAL:** Disturbed soil samples  
**No. and type of samples:** 9 jar samples  
**Source or other identification:** Borings: 1 through 5

**Date received:** 17 April 84

**REMARKS:**

Results of Tests

Table 1

Advance data sent 8 May 84.

**Report sent to:**

Tulsa District

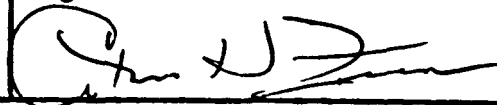
**Copy furnished:**

**Date:**

19 May 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**





## Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis			Atterberg Limits				Water Content %	Description
				Gr	Sa	Fi	LL	PL	PI	LS		
38-1	J-2	G-6264	1.0- 2.0	2	36	62	22	17	5		16.1	ML-CL SILT, sandy, gray, moist.
	J-6	G-6268	7.0-10.0	0	8	92	27	19	8		22.7	CL CLAY, gray, moist.
38-2	J-2	G-6270	1.0- 2.0									ML SILT, gray, moist.
	J-6	G-6274	6.0- 7.0									ML SILT, gray, moist.
38-3	J-2	G-6277	1.0- 2.0									ML SILT, gray, moist.
	J-7	G-6282	6.0- 7.0									CL CLAY, gray, moist.
38-4	J-2	G-6286	1.0- 2.0									ML SILT, gray, moist.
38-5	J-4	G-6294	6.2- 7.4	4	53	43	20	16	4		19.6	SM-SC SAND, silty, gray, moist.
	J-6	G-6296	8.5- 9.5	1	43	56	20	17	3		18.0	ML SILT, sandy, gray, moist.

Table 1

Pine Bluff Arsenal  
Site 38

## Results of Chemical Analysis of Soil(1)

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Sc	Zn
6263	38-1	J-1	0.0-1.0				< 0.5			11		9.7
6264		J-2	1.0-2.0				< 0.5			12		200
6269	38-2	J-1	0.0-1.0				< 0.5			10		200
6270		J-2	1.0-2.0				< 0.5			6.5		36
6276	38-3	J-1	0.0-1.0				< 0.5			14		60
6277		J-2	1.0-2.0				< 0.5			10		18
6285	38-4	J-1	0.0-1.0				< 0.5			17		190
6286		J-2	1.0-2.0				< 0.5			9.2		13
6291	38-5	J-1	0.0-0.3	< 0.5	< 1.0	< 20	< 0.5	6.7	< 0.1	13	< 0.1	18000
6292		J-2	4.8-5.2	< 0.5	1.0	34	< 0.4	6.6	< 0.1	13	< 0.1	1300
6293		J-3	5.2-6.2	< 0.5	< 1.0	< 20	< 0.5	< 5.0	< 0.1	9.3	< 0.1	520
6294		J-4	6.2-7.4				< 0.5			9.6		220
6295		J-5	7.4-8.5				< 0.5			8.8		59
6296		J-6	8.5-9.5				< 0.5			9.3		240
Minimum reported concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0

(1) Results reported in mg/kg.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS  
4815 Cass Street  
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13759-3 ( 2 pages)

PROJECT: *Pine Bluff Arsenal*  
Feature: *Closed Hazardous Waste Site 38*

Contract No.:

TEST REQUEST NO.: *Telephone*  
Dated: *24 July 84*  
Received:

From: *Chief*  
*Geotechnical Branch*  
*Tulsa District*

MATERIAL: *Disturbed soil samples*  
No. and type of samples: *6 jar samples,*  
Source or other identification: *Boring MW-172*

Date received: *20 July 84*

REMARKS:

*Results of Tests*

*Table 1*

*Advance data sent 1 Aug 84*

Report sent to:

*Tulsa District*

Copy furnished:

Date:

*8-21-84*

Name and title:  
ARTHUR H. FEESE  
Director  
SWD Laboratory

Signature

*Arthur H. Feeze*

SHDLD-GL Report 13759-3

### Results of Tests of <sup>Table 1</sup> Disturbed Soil Samples

Arie Bluff Arsenal-Site 38

Boring No.	Field No.	SND No.	Depth ft.	Mechanical Analysis			Atterberg Limits				Water Content %	Dry Density lb/cu ft	Test		Description
				Gr	Sp	Fl	LL	PL	PI	LS			Type	Plate	
MW-172	J-1	6/7192	0.0-1.5	34	41	25	26	12	14	2.9			SC	SAND, clayey, gravelly, yellow brown, damp, insufficient material for bar shrinkage.	
	J-2	7193	1.5-6.8	0	27	73	NP	NP	NP	3	14.9		ML	SILT, sandy, gray, moist.	
	J-3	7194	6.8-11.6	0	60	40	NP	NP	NP	0	7.9		SM	SAND, silty, light yellow brown, damp.	
	J-4	7195	11.8-16.8	0	44	56	NP	NP	NP	0	18.9		ML	SILT, sandy, gray brown and yellow brown, moist.	
	J-5	7196	16.8-20.5	0	89	11	NP	NP	NP	1	19.2		SMSP	SAND, silty, light yellow brown, moist.	
	J-13	7204	52.0-53.3	0	96	4	NP	NP	NP	0	26.5		SP	SAND, yellow brown, wet.	

\* Actual length of sample in feet

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

**SUBMITTAL OF SWDED-GL REPORT 13759-4 ( 9 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 20 June 84  
**Received:**

**From:** Chief  
Geotech Branch  
Tulsa District

**MATERIAL:** Water and Sediment  
**No. and type of samples:** 1 water and 1 sediment  
**Source or other identification:** Water sample 38-WS-1 and  
Sediment sample 38-SD-3

**Date received:** 21 May, 21 June 84

**REMARKS:**

Results of tests for Priority Pollutants conducted by Continental  
Technical Services, Dallas, TX.

Results of tests telephoned to TDO on 31 July 84.

**Report sent to:**

Tulsa District

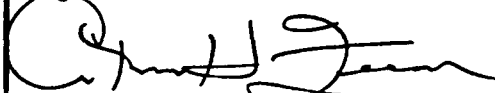
**Copy furnished:**

**Date:**

5 Sep 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**





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9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343-2025

CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS

P.O. BOX 61

TULSA, OK 74121

NDPES PART 2C

PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2931

MATRIX - WATER

FIELD #6916

SITE 38 POND (WS-1)

### VOLATILE COMPOUNDS

### RESULTS

### DETECTION LIMITS

1V. ACROLEIN	ND	0.01 mg/l
2V. ACRYLONITRILE	ND	0.01 mg/l
3V. BENZENE	ND	0.001 mg/l
4V. BIS (CHLOROMETHYL) ETHER	ND	0.001 mg/l
5V. BROMOFORM	ND	0.005 mg/l
6V. CARBON TETRACHLORIDE	ND	0.001 mg/l
7V. CHLOROBENZE	ND	0.006 mg/l
8V. CHLORODIBROMOMETHANE	ND	0.005 mg/l
9V. CHLOROETHANE	ND	0.001 mg/l
10V. 2-CHLOROETHYL VINYL ETHER	ND	0.001 mg/l
11V. CHLOROFORM	ND	0.002 mg/l
12V. DICHLOROBROMOMETHANE	ND	0.002 mg/l
13V. DICHLORODIFLUOROMETHANE	ND	0.01 mg/l
14V. 1,1-DICHLOROETHANE	ND	0.005 mg/l
15V. 1,2-DICHLOROETHANE	ND	0.005 mg/l
16V. 1,1-DICHLOROETHYLENE	ND	0.006 mg/l
17V. 1,2-DICHLOROPROPANE	ND	0.005 mg/l
18V. 1,2-DICHLOROPROPYLENE	ND	0.005 mg/l
19V. ETHYLBENZENE	ND	0.007 mg/l
20V. METHYL BROMIDE	ND	0.01 mg/l
21V. METHYL CHLORIDE	ND	0.01 mg/l
22V. METHYLENE CHLORIDE	ND	0.001 mg/l
23V. 1,1,2,2-TETRACHLOROETHANE	ND	0.006 mg/l
24V. TETRACHLOROETHYLENE	ND	0.001 mg/l
25V. TOLUENE	ND	0.001 mg/l
26V. 1,2-TRANS-DICHLOROETHYLENE	ND	0.005 mg/l
27V. 1,1,1-TRICHLOROETHANE	ND	0.001 mg/l
28V. 1,1,2-TRICHLOROETHANE	ND	0.005 mg/l
29V. TRICHLOROETHYLENE	ND	0.001 mg/l
30V. TRICHLOROFLUOROMETHANE	ND	0.01 mg/l
31V. VINYL CHLORIDE	ND	0.01 mg/l



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CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS  
P.O. BOX 61  
TULSA, OK 74121

NPDES PART 2C  
PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2931

MATRIX - WATER

FIELD #6916  
SITE 38 POND (WS-1)

### ACID EXTRACTABLE COMPOUNDS

### RESULTS

### DETECTION LIMITS

1A. 2-CHLOROPHENOL	ND	0.03 mg/l
2A. 2,4-DICHLOROPHENOL	ND	0.03 mg/l
3A. 2,4-DIMETHYLPHENOL	ND	0.02 mg/l
4A. 4,6-DINITRO-O-CRESOL	ND	0.18 mg/l
5A. 2,4-DINITROPHENOL	ND	0.63 mg/l
6A. 2-NITROPHENOL	ND	0.04 mg/l
7A. 4-NITROPHENOL	ND	0.15 mg/l
8A. P-CHLORO-M-CRESOL	ND	0.03 mg/l
9. PENTACHLOROPHENOL	ND	0.11 mg/l
10. PHENOL	0.13	0.02 mg/l
11A. 2,4,6-TRICHLOROPHENOL	ND	0.04 mg/l

### BASE/NEUTRAL EXTRACTABLE COMPOUNDS

### RESULTS

### DETECTION LIMITS

1B. ACENAPHTHENE	ND	0.008 mg/l
2B. ACENAPHTYLENE	ND	0.014 mg/l
3B. ANTHRACENE	ND	0.008 mg/l
4B. BENZIDINE	ND	0.18 mg/l
5B. BENZO (a) ANTHRACENE	ND	0.031 mg/l
6B. BENZO (a) PYRENE	ND	0.010 mg/l
7B. 2,4-BENZOFUORANTHENE	ND	0.019 mg/l
8B. BENZO (ghi) PERYLENE	ND	0.016 mg/l
9B. BENZO (k) FLUORANTHENE	ND	0.010 mg/l
10B. BIS (2-CHLOROETHOXY) METHANE	ND	0.021 mg/l
11B. BIS (2-CHLOROETHYL) ETHER	ND	0.023 mg/l
12B. BIS (2-CHLOROISOPROPYL) ETHER	ND	0.023 mg/l
13B. BIS (2-ETHYLHEXYL) PHTHALATE	ND	0.010 mg/l
14B. 4-BROMOPHENYL PHENYL ETHER	ND	0.008 mg/l
15B. BUTYL BENZYL PHTHALATE	ND	0.010 mg/l
16B. 2-CHLORONAPHTHALENE	ND	0.008 mg/l
17B. 4-CHLOROPHENYL PHENYL ETHER	ND	0.017 mg/l
18B. CHRYSENE	ND	0.010 mg/l
19B. BENZO (a,h) ANTHRACENE	ND	0.010 mg/l
20B. 1,2-DICHLOROBENZENE	ND	0.008 mg/l



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CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS  
P.O. BOX 61  
TULSA, OK 74121

NPDES PART 2C  
PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2931

MATRIX - WATER

FIELD #6916  
SITE 38 POND (WS-1)

<u>BASE/NEUTRAL EXTRACTABLE COMPOUNDS CONTINUED</u>	<u>RESULTS</u>	<u>DETECTION LIMITS</u>
21B. 1,3-DICHLOROBENZENE	ND	0.008 mg/l
22B. 1,4-DICHLOROBENZENE	ND	0.008 mg/l
23B. 3,3-DICHLOROBENZIDINE	ND	0.066 mg/l
24B. DIETHYL PHTHALATE	ND	0.007 mg/l
25B. DIMETHYL PHTHALATE	ND	0.007 mg/l
26B. DI-N-BUTYL PHTHALATE	ND	0.010 mg/l
27B. 2,4-DINITROTOLUENE	ND	0.023 mg/l
28B. 2,6-DINITROTOLUENE	ND	0.008 mg/l
29B. DI-N-OCTYL PHTHALATE	ND	0.010 mg/l
30B. 1,2-DIPHENYL HYDRAZINE (AS AZOBENZENE)	ND	mg/l
31B. FLUORANTHENE	ND	0.009 mg/l
32B. FLUORENE	ND	0.008 mg/l
33B. HEXACHLOROBENZENE	ND	0.008 mg/l
34B. HEXACHLOROBUTADIENE	ND	0.004 mg/l
35B. HEXACHLOROCYCLOPENTADIENE	ND	mg/l
36B. HEXACHLOROETHANE	ND	0.006 mg/l
37B. INDENO (1,2,3-cd) PYRENE	ND	0.015 mg/l
38B. ISOPHORONE	ND	0.009 mg/l
39B. NAPHTHALENE	ND	0.006 mg/l
40B. NITROBENZENE	ND	0.008 mg/l
41B. N-NITRO-SODIMETHYLAMINE	ND	mg/l
42B. N-NITROSODI-N-PROPYLAMINE	ND	mg/l
43B. N-NITROSODIPHENYLAMINE	ND	0.008 mg/l
44B. PHENANTHRENE	ND	0.022 mg/l
45B. PYRENE	ND	0.008 mg/l
46B. 1,2,4-TRICHLOROBENZENE	ND	0.008 mg/l





## Continental Technical Services

A Division of The Continental Insurance Companies

THE ENVIRONMENTAL HEALTH LABORATORY  
of  
CONTINENTAL TECHNICAL SERVICES  
9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343-2025

CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS  
P.O. BOX 61  
TULSA, OK 74121

NPDES PART 2C  
PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2931

MATRIX - SOIL

FIELD #6916  
SITE 38 POND (WS-1)

### PESTICIDE COMPOUNDS

### RESULTS

### DETECTION LIMITS

1P. ALDRIN	ND	0.008 mg/l
2P. $\alpha$ -BHC	ND	mg/l
3P. $\beta$ -BHC	ND	0.017 mg/l
4P. $\gamma$ -BHC	ND	mg/l
5P. $\delta$ -BHC	ND	0.012 mg/l
6P. CHLORDANE	ND	mg/l
7P. 4,4-DDT	ND	0.019 mg/l
8P. 4,4-DDE	ND	0.022 mg/l
9P. 4-DDD	ND	0.011 mg/l
10P. DIELDRIN	ND	0.010 mg/l
11P. $\alpha$ -ENDOSULFAN	ND	mg/l
12P. $\beta$ -ENDOSULFAN	ND	mg/l
13P. ENDOSULFAN SULFATE	ND	0.022 mg/l
14P. ENDRIN	ND	mg/l
15P. ENDRIN ALDEHYDE	ND	mg/l
16P. HEPTACHLOR	ND	0.008 mg/l
17P. HEPTACHLOR EPOXIDE	ND	0.009 mg/l
18P. PCB-1242	ND	0.12 mg/l
19P. PCB-1254	ND	0.14 mg/l
20P. PCB-1221	ND	0.12 mg/l
21P. PCB-1232	ND	0.12 mg/l
22P. PCB-1248	ND	0.14 mg/l
23P. PCB-1260	ND	0.14 mg/l
24P. PCB-1016	ND	0.12 mg/l
25P. TOXAPHENE	ND	mg/l

COMMENTS:

THANK YOU!

ROGER HALLSTEIN, Ph.D.  
LABORATORY MANAGER



## Continental Technical Services

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CONTINENTAL TECHNICAL SERVICES

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CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS

P.O. BOX 61

TULSA, OK 74121

NDPES PART 2C

PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2929

MATRIX - WATER

FIELD #6719

SITE 38 (38-SD-3)

### VOLATILE COMPOUNDS

### RESULTS

### DETECTION LIMIT

1V. ACROLEIN	ND	0.01 mg/l
2V. ACRYLONITRILE	ND	0.01 mg/l
3V. BENZENE	.009	0.002 mg/l
4V. BIS (CHLOROMETHYL) ETHER	ND	0.014 mg/l
5V. BROMOFORM	ND	0.006 mg/l
6V. CARBON TETRACHLORIDE	3.19	0.003 mg/l
7V. CHLOROBENZENE	ND	0.003 mg/l
8V. CHLORODIBROMOMETHANE	ND	0.003 mg/l
9V. CHLOROETHANE	0.015	0.003 mg/l
10V. 2-CHLOROETHYL VINYL ETHER	ND	0.014 mg/l
11V. CHLOROFORM	20.6	0.005 mg/l
12V. DICHLOROBROMOMETHANE	ND	0.003 mg/l
13V. DICHLORODIFLUOROMETHANE	ND	0.006 mg/l
14V. 1,1-DICHLOROETHANE	ND	0.003 mg/l
15V. 1,2-DICHLOROETHANE	0.028	0.006 mg/l
16V. 1,1-DICHLOROETHYLENE	ND	0.003 mg/l
17V. 1,2-DICHLOROPROPANE	ND	0.006 mg/l
18V. 1,2-DICHLOROPROPYLENE	ND	0.011 mg/l
19V. ETHYLBENZENE	ND	0.003 mg/l
20V. METHYL BROMIDE	ND	0.006 mg/l
21V. METHYL CHLORIDE	ND	0.006 mg/l
22V. METHYLENE CHLORIDE	3.52	0.004 mg/l
23V. 1,1,2,2-TETRACHLOROETHANE	0.691	0.004 mg/l
24V. TETRACHLOROETHYLENE	21.3	0.006 mg/l
25V. TOLUENE	0.112	0.002 mg/l
26V. 1,2-TRANS-DICHLOROETHYLENE	ND	0.003 mg/l
27V. 1,1,1-TRICHLOROETHANE	0.080	0.003 mg/l
28V. 1,1,2-TRICHLOROETHANE	ND	0.004 mg/l
29V. TRICHLOROETHYLENE	0.050	0.006 mg/l
30V. TRICHLOROFUOBROMOMETHANE	ND	0.014 mg/l
31V. VINYL CHLORIDE	0.014	0.006 mg/l



# Continental Technical Services

Unit of The Continental Insurance Companies

THE ENVIRONMENTAL HEALTH LABORATORY  
of

CONTINENTAL TECHNICAL SERVICES

9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343 2025

CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS

P.O. BOX 61

TULSA, OK 74121

NPDES PART 2C

PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2929

MATRIX - WATER

FIELD #6719

SITE 38 (38-SD-3)

## ACID EXTRACTABLE COMPOUNDS

## RESULTS

## DETECTION LIMITS

1A. 2-CHLOROPHENOL	ND	1.5 mg/kg
2A. 2,4-DICHLOROPHENOL	ND	4.0 mg/kg
3A. 2,4-DIMETHYLPHENOL	ND	3.0 mg/kg
4A. 4,6-DINITRO-O-CRESOL	ND	17 mg/kg
5A. 2,4-DINITROPHENOL	ND	135 mg/kg
6A. 2-NITROPHENOL	ND	6.0 mg/kg
7A. 4-NITROPHENOL	ND	3.5 mg/kg
8A. 4-CHLORO-3-METHYLPHENOL	ND	3.5 mg/kg
9A. PENTACHLOROPHENOL	ND	5.5 mg/kg
10A. PHENOL	ND	3.0 mg/kg
11A. 2,4,6-TRICHLOROPHENOL	ND	3.5 mg/kg

## BASE/NEUTRAL EXTRACTABLE COMPOUNDS

## RESULTS

## DETECTION LIMITS

1B. ACENAPHTHENE	ND	1.0 mg/kg
2B. ACENAPHTYLENE	ND	1.0 mg/kg
3B. ANTHRACENE	ND	1.0 mg/kg
4B. BENZIDINE	ND	1.5 mg/kg
5B. BENZO (a) ANTHRACENE	ND	3.0 mg/kg
6B. BENZO (a) PYRENE	ND	2.0 mg/kg
7B. 2,4-BENZOFUORANTHENE	ND	2.5 mg/kg
8B. BENZO (ghi) PERYLENE	ND	3.0 mg/kg
9B. BENZO (k) FLUORANTHENE	ND	2.5 mg/kg
10B. BIS (2-CHLOROETHOXY) METHANE	ND	3.0 mg/kg
11B. BIS (2-CHLOROETHYL) ETHER	ND	3.5 mg/kg
12B. BIS (2-CHLOROISOPROPYL) ETHER	ND	1.5 mg/kg
13B. BIS (2-ETHYLHEXYL) PHTHALATE	ND	2.5 mg/kg
14B. 4-BROMOPHENYL PHENYL ETHER	ND	1.5 mg/kg
15B. BUTYL BENZYL PHTHALATE	ND	1.5 mg/kg
16B. 2-CHLORONAPHTHALENE	28.5	1.5 mg/kg
17B. 4-CHLOROPHENYL PHENYL ETHER	ND	2.0 mg/kg
18B. CHRYSENE	ND	1.5 mg/kg
19B. BENZO (a,h) ANTHRACENE	ND	5.0 mg/kg
20B. 1,2-DICHLOROBENZENE	ND	2.5 mg/kg



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CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS  
P.O. BOX 61  
TULSA, OK 74121

NPDES PART 2C  
PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2929

MATRIX - WATER

FIELD #6719  
SITE 38 (38-SD-3)

<u>BASE/NEUTRAL EXTRACTABLE COMPOUNDS CONTINUED</u>	<u>RESULTS</u>	<u>DETECTION LIMIT</u>
21B. 1,3-DICHLOROBENZENE	ND	2.5 mg/k
22B. 1,4-DICHLOROBENZENE	ND	2.0 mg/k
23B. 3,3-DICHLOROBENZIDINE	ND	mg/k
24B. DIETHYL PHTHALATE	ND	1.0 mg/k
25B. DIMETHYL PHTHALATE	ND	1.0 mg/k
26B. DI-N-BUTYL PHTHALATE	6.65	0.5 mg/k
27B. 2,4-DINITROTOLUENE	ND	17 mg/k
28B. 2,6-DINITROTOLUENE	ND	6.0 mg/k
29B. DI-N-OCTYL PHTHALATE	ND	0.5 mg/k
30B. 1,2-DIPHENYL HYDRAZINE (AS AZOBENZENE)	ND	mg/k
31B. FLUORANTHENE	ND	1.0 mg/k
32B. FLUORENE	ND	1.0 mg/k
33B. HEXACHLOROBENZENE	ND	1.0 mg/k
34B. HEXACHLOROBUTADIENE	ND	mg/k
35B. HEXACHLOROCYCLOPENTADIENE	ND	11 mg/k
36B. HEXACHLOROETHANE	ND	4.0 mg/k
37B. INDENO (1,2,3-cd) PYRENE	ND	mg/k
38B. ISOPHORONE	ND	1.5 mg/k
39B. NAPHTHALENE	16.3	1.0 mg/k
40B. NITROBENZENE	ND	4.0 mg/k
41B. N-NITRO-SODIMETHYLAMINE	ND	mg/k
42B. N-NITROSODI-N-PROPYLAMINE	ND	3.5 mg/k
43B. N-NITROSODIPHENYLAMINE	ND	2.5 mg/k
44B. PHENANTHRENE	ND	1.0 mg/k
45B. PYRENE	ND	1.5 mg/k
46B. 1,2,4-TRICHLOROBENZENE	ND	2.5 mg/k



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THE ENVIRONMENTAL HEALTH LABORATORY

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CONTINENTAL TECHNICAL SERVICES

9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343 2025

CTEK REPORT 84-0814

U.S. ARMY CORPS OF ENGINEERS

P.O. BOX 61

TULSA, OK 74121

NPDES PART 2C

PRIORITY POLLUTANTS

P.O. NUMBER: DACW63-84-M-1171

EHL SAMPLE #E2929

MATRIX - SOIL

FIELD #6719

SITE 38 (38-SD-3)

## PESTICIDE COMPOUNDS

## RESULTS

## DETECTION LIMITS

1P. ALDRIN	ND	1.0 mg/kg
2P. α-BHC	ND	mg/kg
3P. β-BHC	ND	2.0 mg/kg
4P. γ-BHC	ND	3.0 mg/kg
5P. δ-BHC	ND	1.0 mg/kg
6P. CHLORDANE	ND	mg/kg
7P. 4,4-DDT	ND	2.0 mg/kg
8P. 4,4-DDE	72	2.0 mg/kg
9P. 4,4-DDD	ND	1.0 mg/kg
10P. DIELDRIN	ND	1.0 mg/kg
11P. α-ENDOSULFAN	ND	mg/kg
12P. β-ENDOSULFAN	ND	mg/kg
13P. ENDOSULFAN SULFATE	ND	2.0 mg/kg
14P. ENDRIN	ND	10 mg/kg
15P. ENDRIN ALDEHYDE	ND	mg/kg
16P. HEPTACHLOR	ND	5 mg/kg
17P. HEPTACHLOR EPOXIDE	ND	1.0 mg/kg
18P. PCB-1242	ND	15 mg/kg
19P. PCB-1254	ND	18 mg/kg
20P. PCB-1221	ND	15 mg/kg
21P. PCB-1232	ND	15 mg/kg
22P. PCB-1248	ND	18 mg/kg
23P. PCB-1260	ND	18 mg/kg
24P. PCB-1016	ND	15 mg/kg
25P. TOXAPHENE	ND	mg/kg

THANK YOU!

*Robert E. Hallstein*

ROBERT HALLSTEIN, Ph.D.  
LABORATORY MANAGER

SAMPLE #E2929

COMMENTS: THE METHYLENE CHLORIDE EXTRACT OF THE  
SAMPLE HAD 8 SIGNIFICANT PEAKS, 2 OF WHICH WERE PRINCIPLE. ONE WAS  
DIBENZO-PYRONAPHTHALENE AND THE OTHER A CHLORINATED ANALOGUE OF NAPHTHALENE.  
THERE WAS NO HEXACHLOROETHANE AS THOUGHT.

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13759-5 ( 2 pages)

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 24 July 84  
**Received:**

**From:** Chief  
Geotechnical Branch  
Tulsa District

**MATERIAL:** Soil  
**No. and type of samples:** 6 jar samples  
**Source or other identification:** Boring MW-172

**Date received:** 20 July 84

**REMARKS:**

Results of Chemical Analysis of Soil Samples

Table 1

Results of tests telephoned to TDO on 9, 15 Aug 84

**Report sent to:**  
Tulsa District Office

**Copy furnished:**

**Date:**

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



## Results of Chemical Analysis of Soil(1)

<u>SWD Lab No</u>	<u>Site Hole</u>	<u>Field No.</u>	<u>Depth</u>	<u>Ag</u>	<u>As</u>	<u>Ba</u>	<u>Cd</u>	<u>Cr</u>	<u>Hg</u>	<u>Pb</u>	<u>Se</u>	<u>Zn</u>	<u>pH</u>
7192	MW-172	J-1	0.0- 1.5	<0.5	1.3	<20.0	<0.5	15	<0.1	9.7	<0.1	2.8	
7193		J-2	1.5- 6.8	<0.5	1.7	<20.0	<0.5	6.2	<0.1	9.6	<0.1	1.7	
7194		J-3	6.8-11.8	<0.5	<1.0	<20.0	<0.5	15	<0.1	4.5	<0.1	< 1.0	
7195		J-4	11.8-16.8	<0.5	<1.0	<20.0	<0.5	<5.0	<0.1	5.2	<0.1	1.5	
7196		J-5	16.8-20.5	<0.5	<1.0	<20.0	<0.5	<5.0	<0.1	3.1	<0.1	1.5	
7204		J-13	68.0-73.7	<0.5	<1.0	<20.0	<0.5	<5.0	<0.1	1.9	<0.1	1.6	

Minimum Reported Concentration  
(1) Results reported in mg/kg

0.5      1.0      20.0      0.5      5.0      0.1      1.0      0.1      1.0

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS  
4815 Cass Street  
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13759-6 ( 4 pages)

PROJECT: Pine Bluff Arsenal  
Feature: Close Hazardous Waste Site 38

Contract No.:

TEST REQUEST NO.: Telephone  
Dated: 31 July 84  
Received:

From: Chief  
Geotechnical Branch  
Tulsa District

MATERIAL: Soil  
No. and type of samples: 14 jars  
Source or other identification: Holes: 1 thru 5

Date received: 17 Apr 84

REMARKS:

Results of Chemical Analysis of Soil Samples conducted by  
Key Laboratories, Dallas, TX.

Results of tests telephoned to TDO on 29,31 Aug 84

Report sent to:

Tulsa District

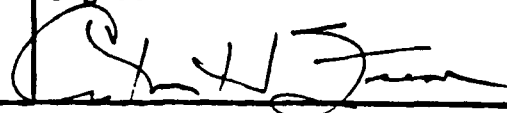
Copy furnished:

Date:

10 Sep 84

Name and title:  
ARTHUR H. FEESE  
Director  
SWD Laboratory

Signature





# KEY LABORATORIES

Division of Production Profits

2636 WALNUT HILL LANE SUITE 275  
DALLAS, TEX. 75229 214/350-5841

September 4, 1984

## REPORT OF ANALYSIS

NUMBER: GH-4020

CLIENT: U.S. Army Corps of Engineers  
Southwest Division Laboratory  
4815 Cass Street  
Dallas, Texas 75235  
Attention: Mr. Jeffrey Tye

DESCRIPTION: The client submitted thirty-seven soil samples for determination of various parameters. The descriptions of the samples are given on the data sheet.

PROCEDURE: The samples were extracted with hexane and analyzed on a Varian 6000 gas chromatograph under the following conditions:

Column	<u>1</u> SPB-5 Capillary	<u>2</u> SPB-5 Capillary
Detector	ECD at 310°C	FID at 310°C
Column Temp.	45-230°C	45-300°C
Attenuation	1	1

RESULTS: See attached data sheet.

Submitted by:

KEY LABORATORIES



Steve T. Jones, Senior Chemist

STJ/kb

# U.S. ARMY CORPS OF ENGINEERS

<u>I.D.</u>	<u>CHCl<sub>3</sub></u>	<u>C<sub>2</sub>Cl<sub>4</sub></u>	<u>C<sub>10</sub>H<sub>7</sub>Cl</u>	<u>p, p' DDT</u>	<u>p, p' DDD</u>	<u>p, p' DDE</u>
6263	0.25	<0.0003	<0.05	<0.01	<0.008	<0.006
6265	0.12	0.006	0.26	<0.01	<0.008	<0.006
6268	0.03	0.008	1.3	<0.01	<0.008	<0.006
6269	0.12	0.007	0.23	<0.01	<0.008	<0.006
6272	0.10	0.006	0.73	<0.01	<0.008	<0.006
6275	0.11	0.007	0.96	<0.01	<0.008	<0.006
6276	0.10	0.004	0.52	<0.01	<0.008	<0.006
6280	<0.001	0.004	0.37	<0.01	<0.008	<0.006
6284	0.11	0.003	0.26	<0.01	<0.008	<0.006
6285	0.09	0.004	0.40	<0.01	<0.008	<0.006
6287	0.15	0.004	0.26	<0.01	<0.008	<0.006
6290	0.10	0.005	0.39	<0.01	<0.008	<0.006
6290*	0.09	0.004	0.27	<0.01	<0.008	<0.006

\* Duplicate analysis.

Results reported in parts per million.

CHCl<sub>3</sub> -Chloroform

C<sub>2</sub>Cl<sub>4</sub> -Tetrachloroethylene

C<sub>10</sub>H<sub>7</sub>Cl -2-Chloro-Naphthalene

The above samples are identified as follows:

Sample No. 6263, 38-1, J-1, 0.0'-1.0'  
 " 6265, 38-1, J-3, 2.0'-3.0'  
 " 6268, 38-1, J-6, 7.0'-10.0'  
 " 6269, 38-2, J-1, 0.0'-1.0'  
 " 6272, 38-2, J-4, 3.0'-5.0'  
 " 6275, 38-2, J-7, 7.0'-10.0'  
 " 6276, 38-3, J-1, 0.0'-1.0'  
 " 6280, 38-3, J-5, 3.5'-5.5'  
 " 6284, 38-3, J-9, 8.5'-10.0'  
 " 6285, 38-4, J-1, 0.0'-1.0'  
 " 6287, 38-4, J-3, 2.0'-3.0'  
 " 6290, 38-4, J-6, 7.0'-10.0'

U.S. ARMY CORPS OF ENGINEERS

<u>IDENTIFICATION</u>	<u>2-CHLORO-NAPHTHALENE</u>	<u>p. p' DDT</u>	<u>p. p' DDD</u>	<u>p. p' DDE</u>
<sup>93</sup> <del>6229</del>	0.29	<0.01	<0.008	<0.006
6293 Duplicate	0.27	<0.01	<0.008	<0.006
6296	<0.18	<0.04	<0.03	<0.02

Results reported in parts per million.

The above samples are identified as follows:

Sample No. 6293, 38-5, J-3, 512'-6.2'  
" 6296, 38-5, J-6, 8.5'-9.5'

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

**SUBMITTAL OF SWDED-GL REPORT 13759-7 ( 3 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 28 Sept 84  
**Received:**

**From:** Chief  
Geotechnical Branch  
Tulsa District

**MATERIAL:** Soil  
**No. and type of samples:** 7 jar samples  
**Source or other identification:** Holes: 6 and 7

**Date received:** 21,24 Sept 84

**REMARKS:**

Results of Chemical Analysis of Soil Samples      Table 1

Note: The 13 soil and 1 water sample alluded to in the Key Laboratories Report of Analysis included 6 soil samples and a water sample ~~from~~ <sup>from</sup> Site 34 (SWDED-GL Report 13758-7).

Results of tests telephoned to TDO on 25 Oct 84

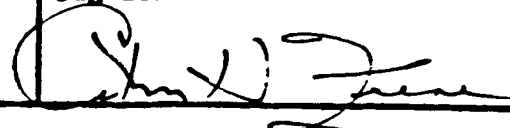
**Report sent to:**  
Tulsa District Office

**Copy furnished:**

**Date:**  
29 Oct 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



KEY LABORATORIES  
Division of Production Profits  
2636 WALNUT HILL LANE SUITE 275  
DALLAS, TEX. 75229 214/350-5841

October 22, 1984

REPORT OF ANALYSIS

NUMBER: GJ-4054

CLIENT: U.S. Army Corps of Engineers  
Southwest Division Laboratory  
4815 Cass Street  
Dallas, Texas 75235  
Attention: Mr. Jeffrey Tye

DESCRIPTION: The client submitted thirteen soil samples and one water sample for determination of various parameters. The descriptions of the samples are given on the data sheet.

PROCEDURE: The samples were extracted with hexane and analyzed on a Varian 6000 gas chromatograph under the following conditions:

	<u>1</u>	<u>2</u>
Column	SPB-5 Capillary	SPB-5 Capillary
Detector	ECD at 310 C	FID at 310 C
Column Temp.	45-230 C	45-300 C
Attenuation	1	1

RESULTS: See attached data sheet.

Submitted by:

KEY LABORATORIES

*Steve Jones*

Steve T. Jones, Senior Chemist

STJ/kb

U.S. ARMY CORPS OF ENGINEERS

Table-1

<u>I.D.</u>	<u>Chloroform</u>	<u>Tetrachloroethylene</u>	<u>2-Chloronaphthalene</u>	<u>p,p'-DDE</u>
7669	19	1.0	<2	<0.01
7672	0.7	1.1	<2	<0.01
7678	1.0	0.9	<2	<0.01
7684	0.8	0.2	<2	<0.01
7686	0.3	0.3	<2	<0.01
7687	1.0	0.2	<2	<0.01
7704	0.4	0.2	<2	<0.01
7704 *	0.4	0.2	<2	<0.01

\* Denotes duplicate analysis

Results are reported in parts per million

Sample No. 7669-Hole 6, J-4, 7.5'-10.5'  
Sample No. 7672-Hole 6, J-7, 16.5'-19.5'  
Sample No. 7678-Hole 6, J-13, 34.5'-37.5'  
Sample No. 7684-Hole 7, J-5, 9.5'-12.5'  
Sample No. 7686-Hole 7, J-7, 16.0'-19.0'  
Sample No. 7687-Hole 7, J-8, 19.0'-22.0'  
Sample No. 7704-Hole 7, J-14, 36.0'-39.5'

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

**SUBMITTAL OF SWDED-GL REPORT 13759-8 ( 2pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 28 Sept 84  
**Received:**

**From:** Chief  
Geotech Branch  
Tulsa District

**MATERIAL:** Soil  
**No. and type of samples:** 9 jar samples  
**Source or other identification:** Holes: 6 and 7

**Date received:** 19 Sept 84

**REMARKS:**

Results of Classification Tests

Table 1

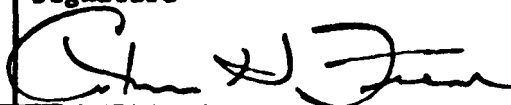
**Report sent to:**  
Tulsa District

**Copy furnished:**

**Date:**  
28 Nov 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



S NO.	FLD NO.	SND NO.	DEPTH, FT.	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
PINE BLUFF ARSENAL SITE 38														
J-8	6/7673		19.5-22.5	0	22	78	24	15	9	5	18.2			CL - CLAY, SANDY, BROWN, MOIST.
J-9	6/7674		22.5-25.5	0	8	92	30	16	14	8	21.7			CL - CLAY, SANDY, GRAYISH BROWN, VERY MOIST.
J-11	6/7676		28.5-31.5	0	2	98	43	19	24	12	26.5			CL - CLAY, BROWN, MOIST.
J-12	6/7677		31.5-34.5	0	2	98	97	19	78		29.0			CH - CLAY, BROWN, MOIST.
J-13	6/7678		34.5-37.5											CH - CLAY, BROWN, MOIST, INSUFFICIENT MATERIAL FOR CLASSIFICATION TESTS.
J-9	6/7688		22.0-24.0	0	13	87	36	13	23	13	21.9			CL - CLAY, BROWN, MOIST.
J-10	6/7689		24.0-27.0	0	23	76	36	16	20	9	22.1			CL - CLAY, SANDY, GRAYISH BROWN, MOIST.
J-11	6/7701		27.0-30.0	0	40	60	20	15	5	3	20.1			ML-CL - SILT, SANDY, GRAY, MOIST.
J-12	6/7702		30.0-33.0	0	9	91	53	19	36	12	29.6			CH - CLAY, GRAYISH BROWN, MOIST.



**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
4815 Cass Street  
Dallas, Texas 75235

**SUBMITTAL OF SWDED-GL REPORT 13759-9 ( 4 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Close Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 29 Oct 84  
**Received:**

**From:** Chief  
Geotech Branch  
Tulsa District

**MATERIAL:** Soil

**No. and type of samples:** 4 jar samples

**Source or other identification:** Hole: 5 and 6

**Date received:** 17 Apr; 19 Sept 84

**REMARKS:**

Results of Chemical Analysis of Soil Samples	Table 1
Results of Chemical Analysis for Chloroform conducted by Key Laboratory using gas chromatograph.	Table 2
Results of Chemical Analysis for Chloroform conducted by Allied Analytical & Research Laboratory using U.S.E.P.A. Method 8240 (GC-MS)	Table 3

Results of tests telephoned to TDO on 2 Nov 84


**Report sent to:**  
Tulsa District

**Copy furnished:**

**Date:**  
28 Nov 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



Results of Chemical Analysis of Soil<sup>(1)</sup>

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn
5	3	6293	5.2- 6.2								0.1	
	4	6294	6.2- 7.4								<0.1	
6	3	7668	4.5- 7.5	See Tables 2 and 3 for results of tests for chloroform								
	5	7670	10.5-13.5	See Tables 2 and 3 for results of tests for chloroform								

Minimum reported concentration	0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0
--------------------------------	-----	-----	------	-----	-----	-----	-----	-----	-----

(1) Results reported in mg/kg

**KEY LABORATORIES**

Division of Production Profits

2636 WALNUT HILL LANE SUITE 275  
DALLAS, TEX 75229 214/350-5841

(SWDED-GL 15759-9)

November 5, 1984

Table 2

**REPORT OF ANALYSIS****NUMBER:** GK-4019**CLIENT:** U.S. Army Corps of Engineers  
Southwest Division Laboratory  
4815 Cass Street  
Dallas, Texas 75235  
Attention: Mr. Jeffrey Tye**DESCRIPTION:** The client submitted two soil samples  
for determination for chloroform.**PROCEDURE:** The samples were extracted with hexane and  
analyzed on a Varian 6000 gas chromatograph  
under the following conditions:

Column -	SPB-5 Capillary
Detector -	ECD @ 310°C
Column Temp. -	45-230°C
Attenuation -	1

<b>RESULTS:</b>	<u>Sample</u>	<u>Chloroform, ppm</u>
38-6, J-3, 4.5'-7.5'	76681	0.36; 0.56
38-6, J-5, 10.5'-13.5'	7670	0.92; 1.00

Submitted by:

KEY LABORATORIES



Steve T. Jones, Senior Chemist

STJ/kb

Table 3

(SWDED-GL 13759-9)

3031 Glenfield  
P.O. Box 24330  
Dallas, Texas 75224

## ALLIED ANALYTICAL &amp; RESEARCH LABORATORIES

*Chemists**Consultants & Technologists*

November 8, 1984

214/337-899



SAMPLE Water

DATE SUBMITTED 11/2/84

IDENTIFYING MARKS See Below

ANALYTICAL REPORT NO. 63646

## SUBMITTED BY

U.S. Army Corps of Engineers  
Attn: Donna Horton

ADDRESS 4815 Cass  
Dallas, TX 75235

## ANALYSIS

Chloroform  
U.S.E.P.A. Method 8240

Sample ID	MDL, ppb	Conc., ppb
PBA 38-6 to 7.5 #3 of 14 7668	5	NA
PBA 38-6 10.5 to 13.5 of 14 7670	4	NA

NA = below minimum detectable level (MDL)

H. Morris Weller, President

ALLIED ANALYTICAL &amp; RESEARCH LABORATORIES, BY \_\_\_\_\_

**SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS**  
**4815 Cass Street**  
**Dallas, Texas 75235**

**SUBMITTAL OF SWDED-GL REPORT 13759-10 ( 2 pages)**

**PROJECT:** Pine Bluff Arsenal  
**Feature:** Closed Hazardous Waste Site 38

**Contract No.:**

**TEST REQUEST NO.:** Telephone  
**Dated:** 19 Oct 84  
**Received:**

**From:** Chief  
Geotechnical Branch  
Tulsa District

**MATERIAL:** Undisturbed Soil Samples  
**No. and type of samples:** 2 Denison samples  
**Source or other identification:** Boring 7A

**Date received:** 19 Oct 84

**REMARKS:**

Results of Tests

Table 1

Advance data sent 21 Nov 84

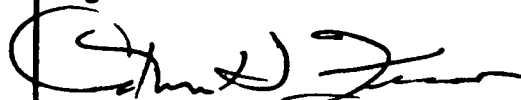
**Report sent to:**  
Tulsa District

**Copy furnished:**

**Date:**  
05 Dec 84

**Name and title:**  
ARTHUR H. FEESE  
Director  
SWD Laboratory

**Signature**



## PINE BLUFF ARSENAL - CLOSED HAZARDOUS WASTE SITE 30

BOREHOLE NO.	FLD NO.	SND NO.	DEPTH, FT.	OR	SA	FI	LL	PL	PI	LS	WC, %	PCF	K, CM/SEC	DESCRIPTION OF MATERIAL
7A	DB-1	04/6427	23.0-25.0	9	10	02	39	15	24	12	23.0	102	2.1 x 10-8	CL - CLAY, GRAY, MOIST, STIFF, WET AND SOFT IN BOTTOM 0.7'.
7A	DB-3	04/6428	20.0-30.0	9	29	71	22	18	4	4	19.0	106	1.6 x 10-7	ML - SILT, SANDY, GRAY BROWN, MOIST, FEW ELLIPSOIDAL VOIDS TO 0.3" x 1.0" NOTED.

APPENDIX II

BORING - CONTAMINANT PLOTS



# LEGEND



CONTAMINATED DEBRIS AND RUBBLE



SAND AND GRAVEL



SILT AND SANDY CLAY



CLAY



CLAY SHALE OR SILTSTONE  
OF THE JACKSON GROUP



SAND OR POORLY CEMENTED SANDSTONE  
OF THE JACKSON GROUP



MIDDEPTH OF SOIL SAMPLE TESTED



BACKGROUND LIMIT

Average concentration of contaminant in  
soil at Pine Bluff Arsenal.  
(or minimum detectable value)



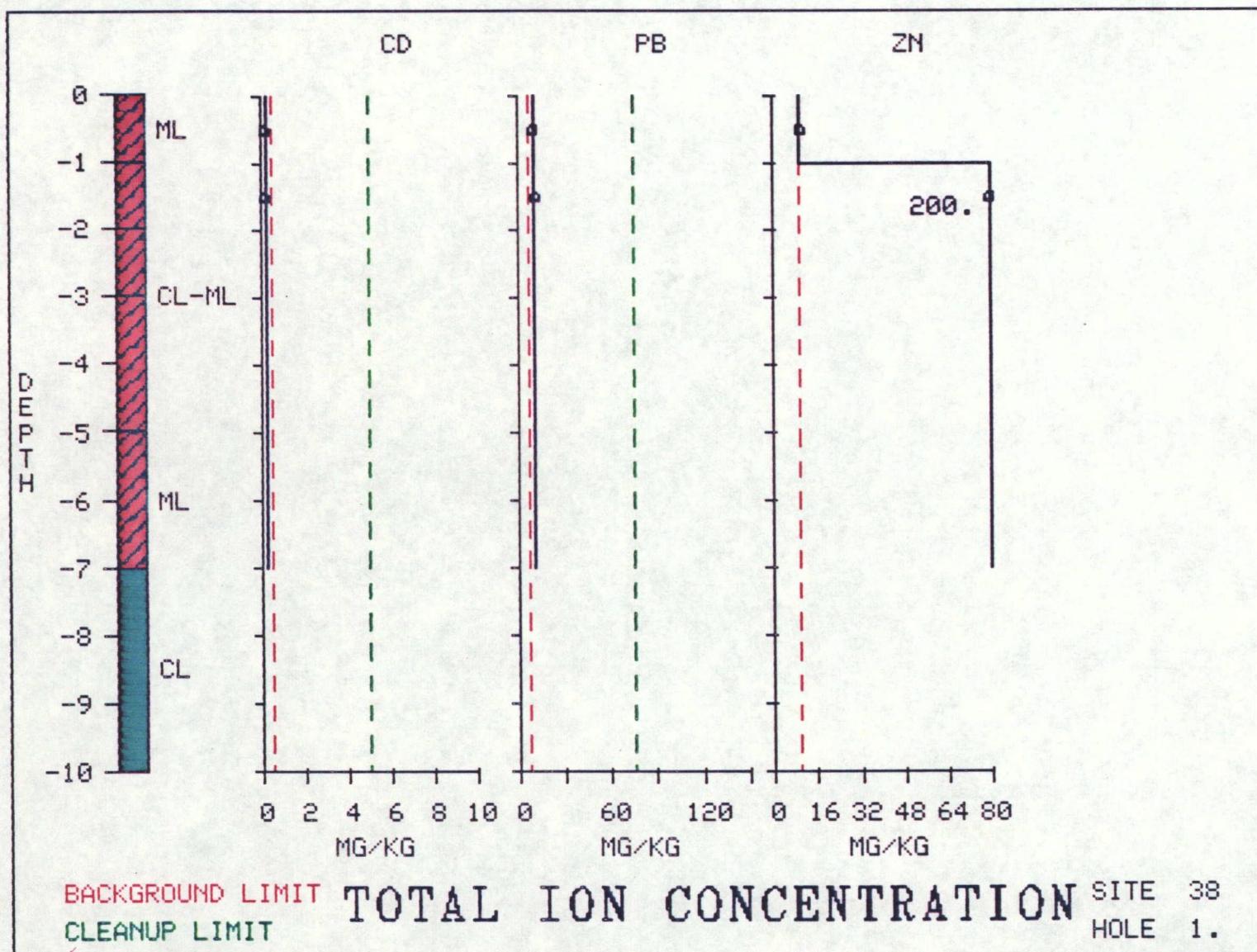
CLEANUP LIMIT

Concentration to which site will be cleaned up  
(10 times background limit). The color "red"  
to the right of the cleanup limit indicates  
contamination.

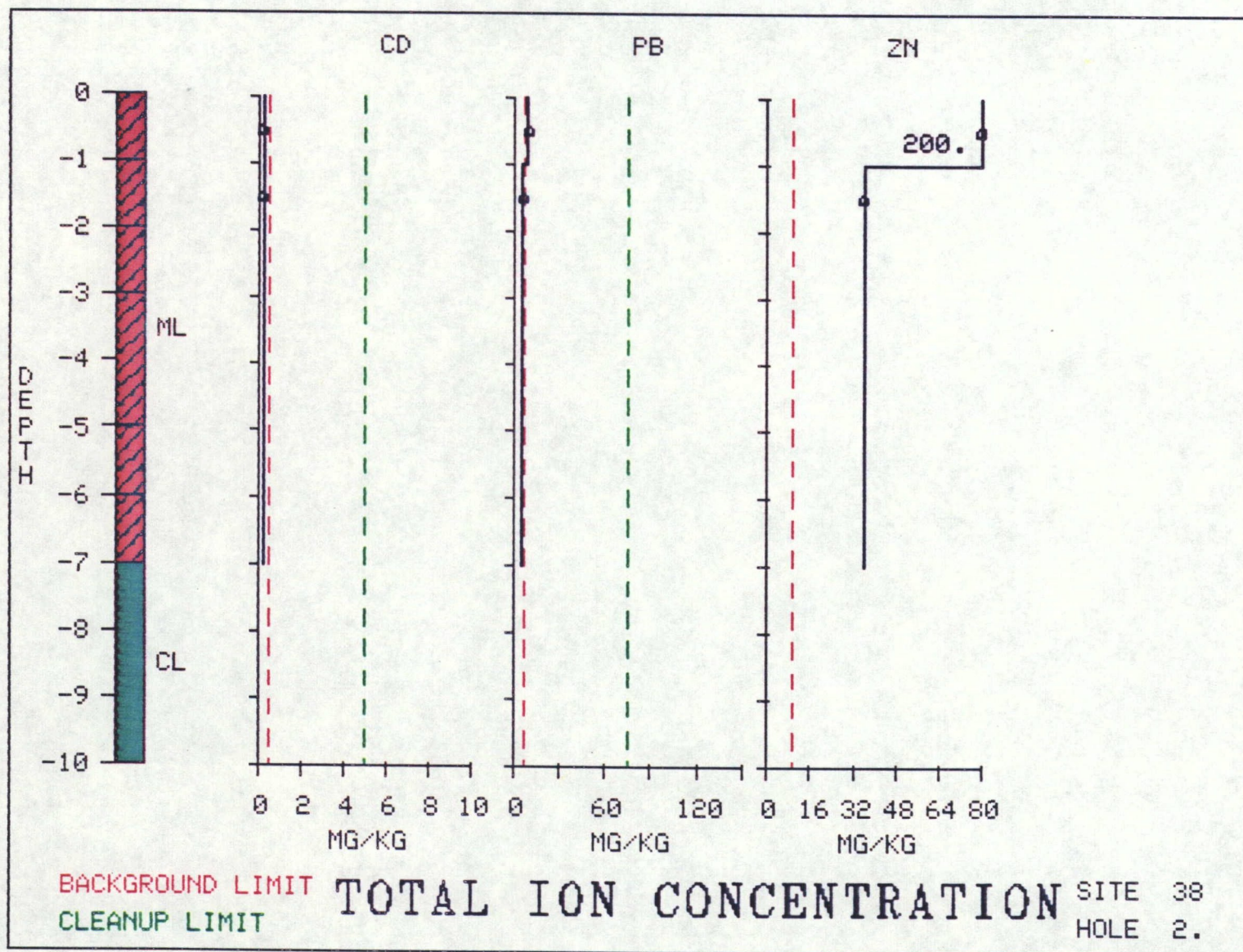
\*EP

LOCATION OF SAMPLE TESTED FOR EP TOXICITY

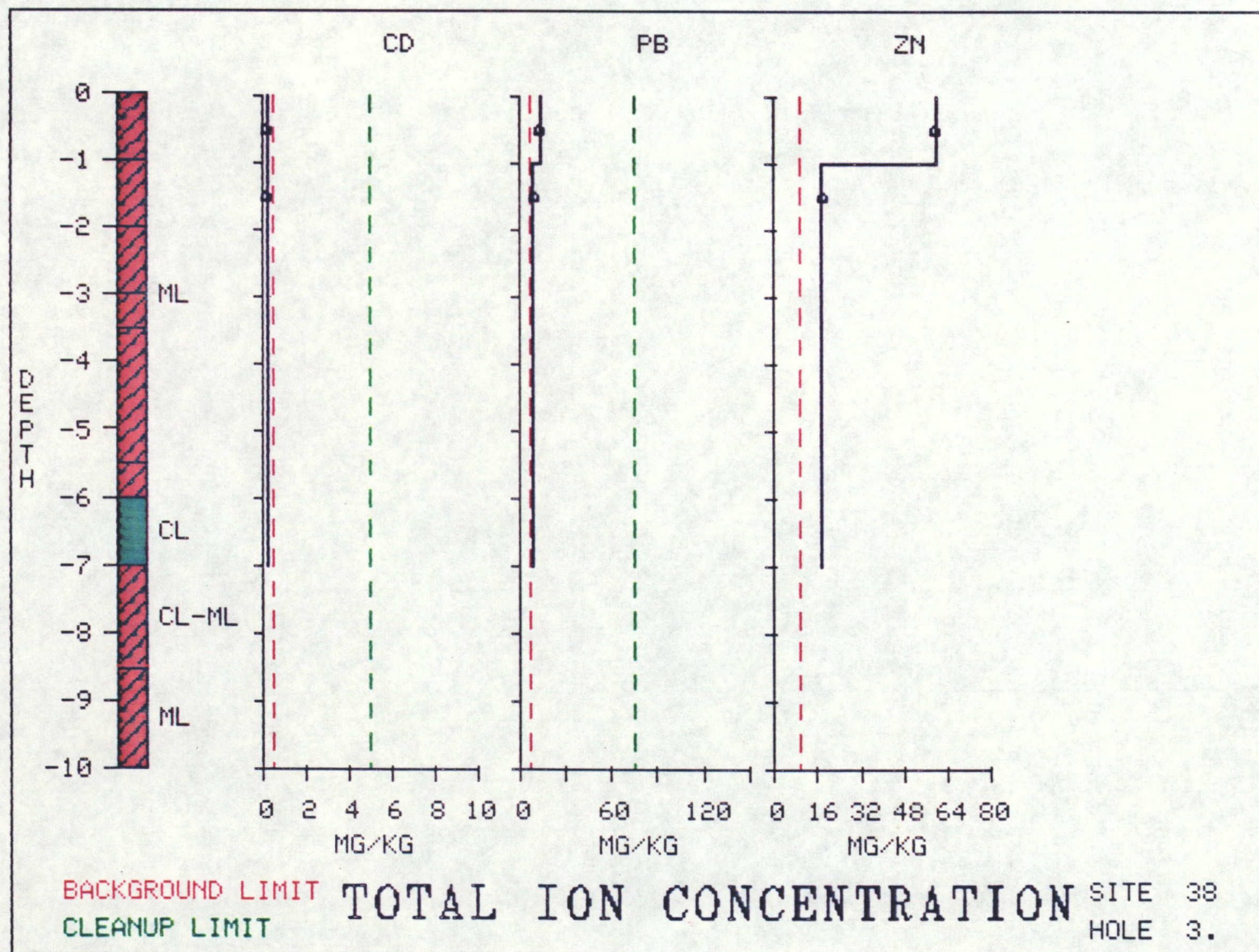




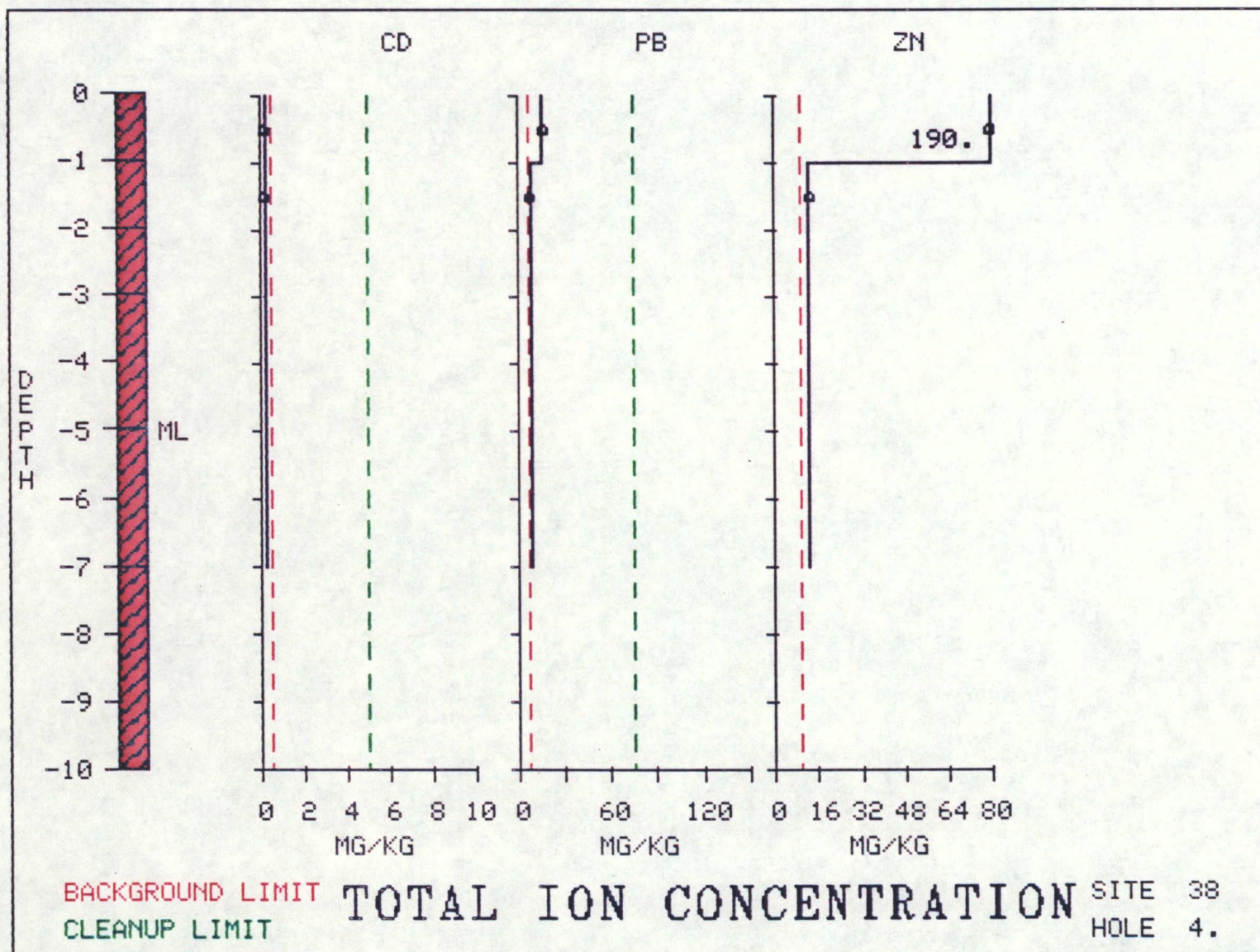




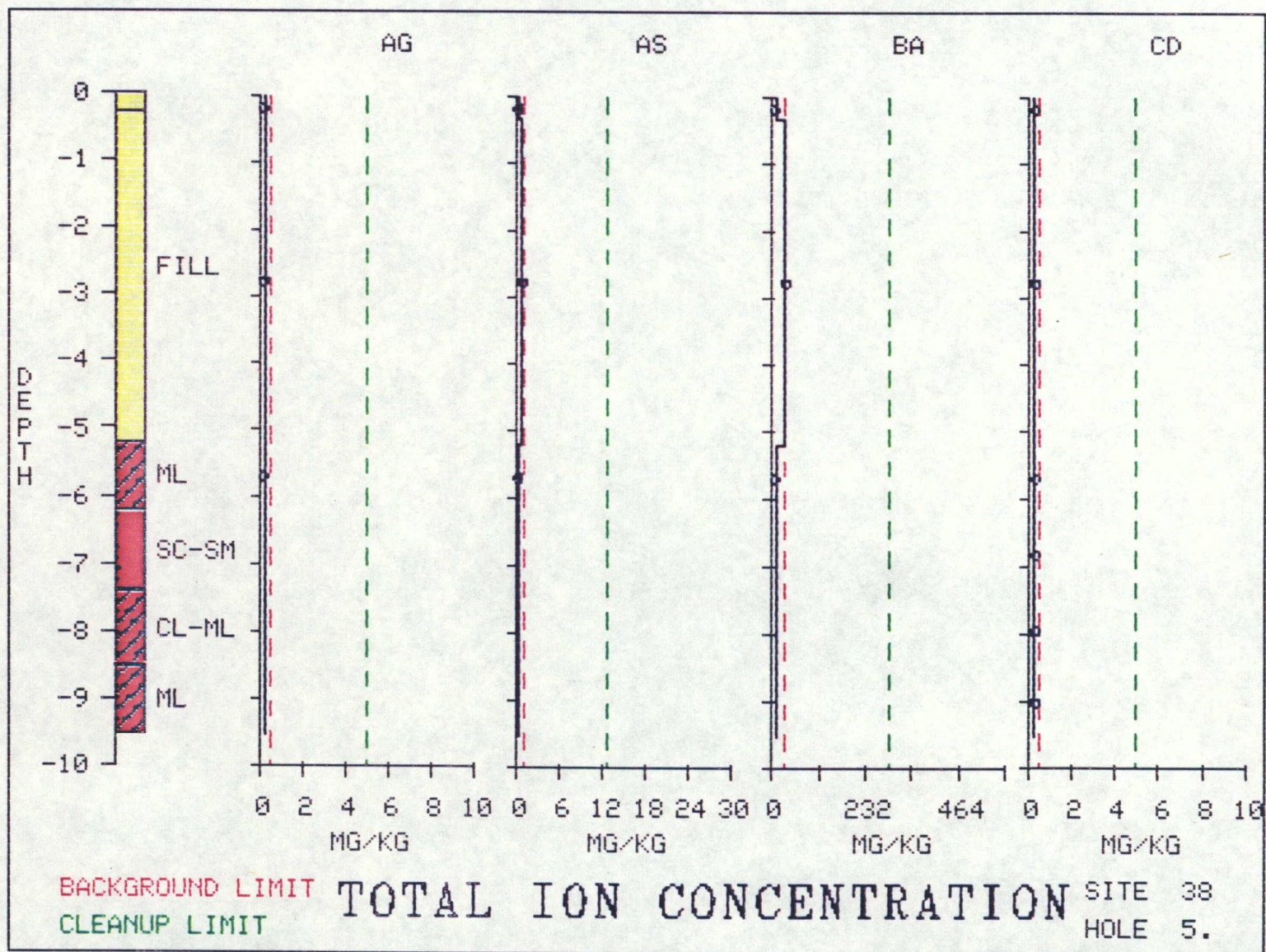




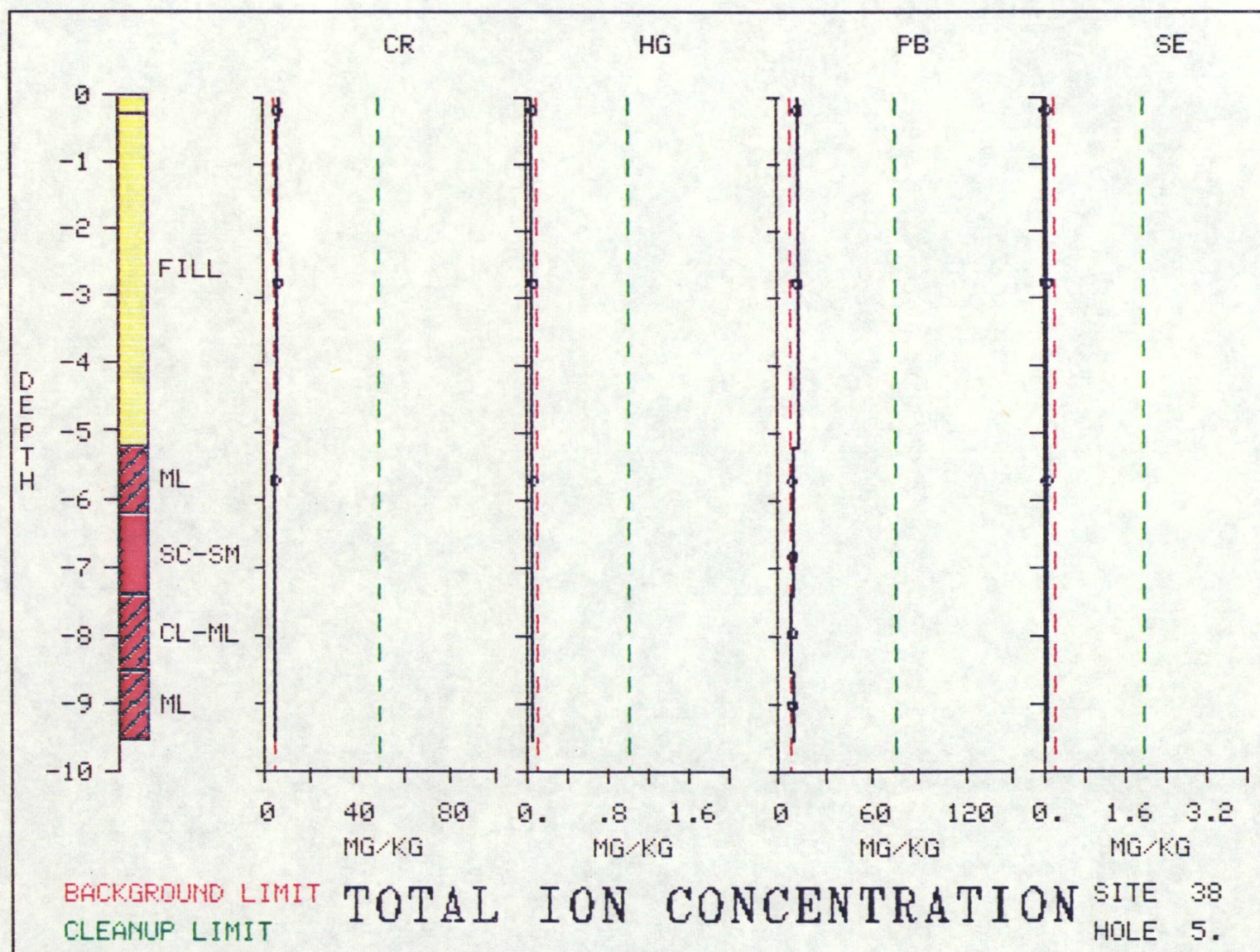




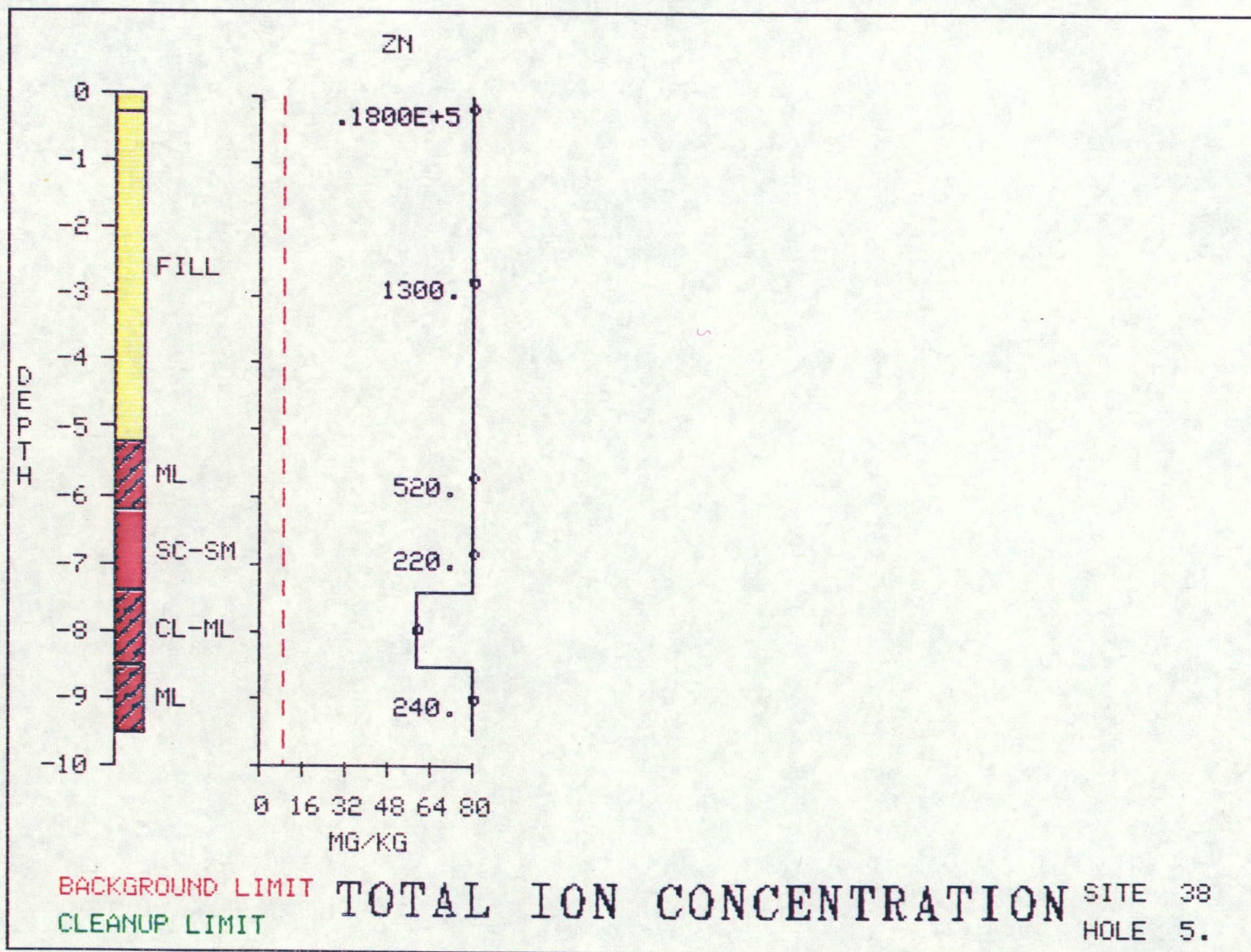




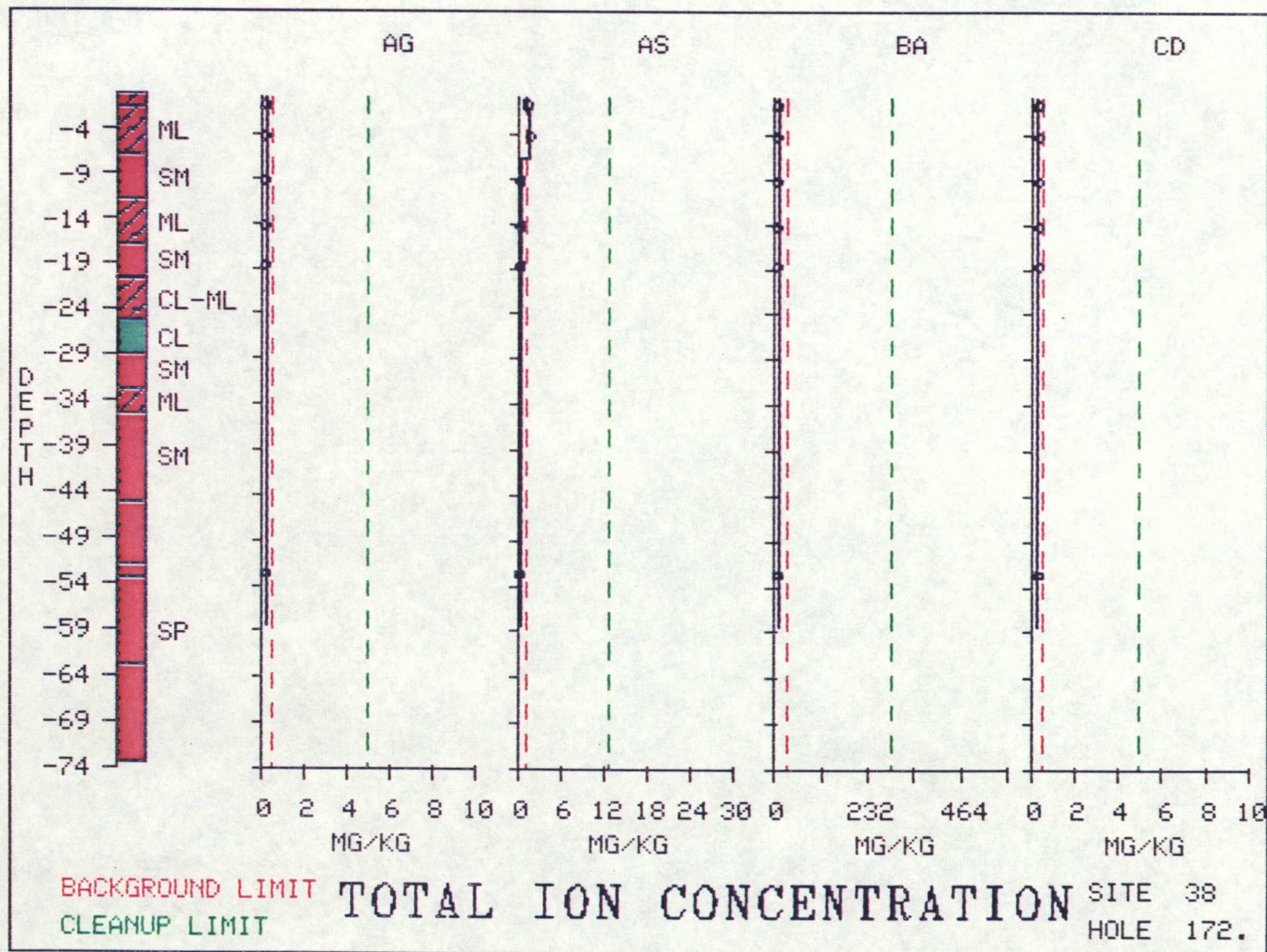




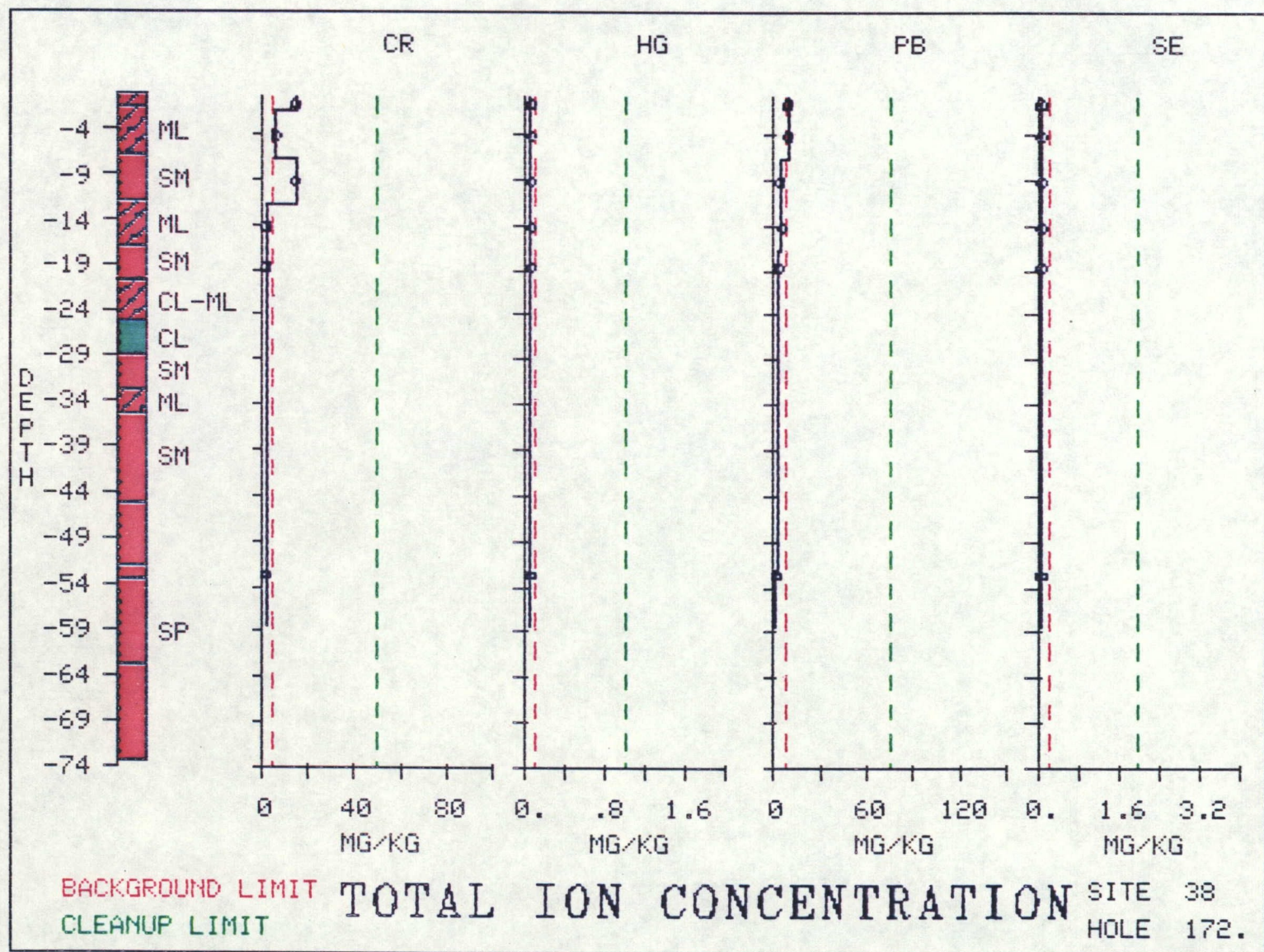




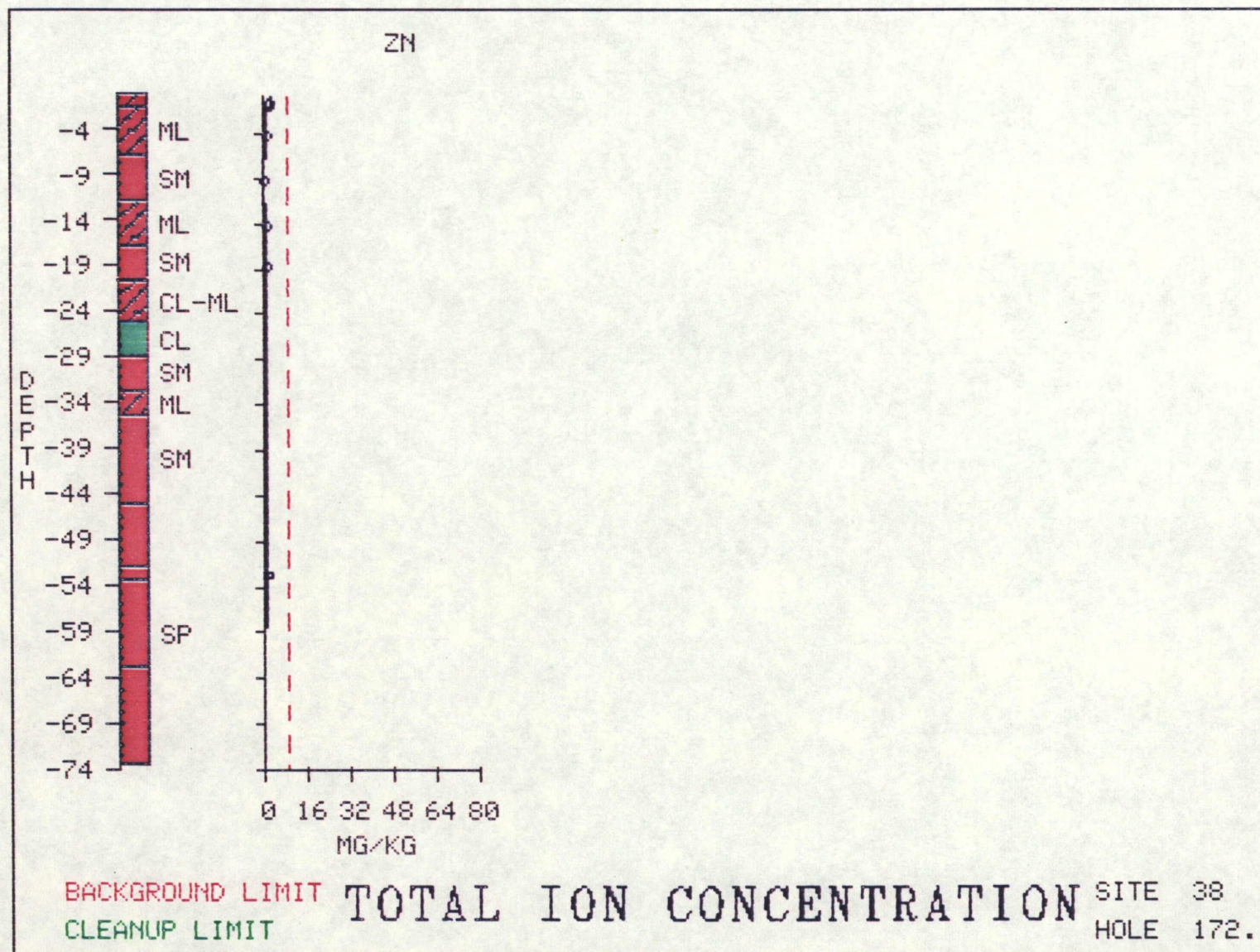




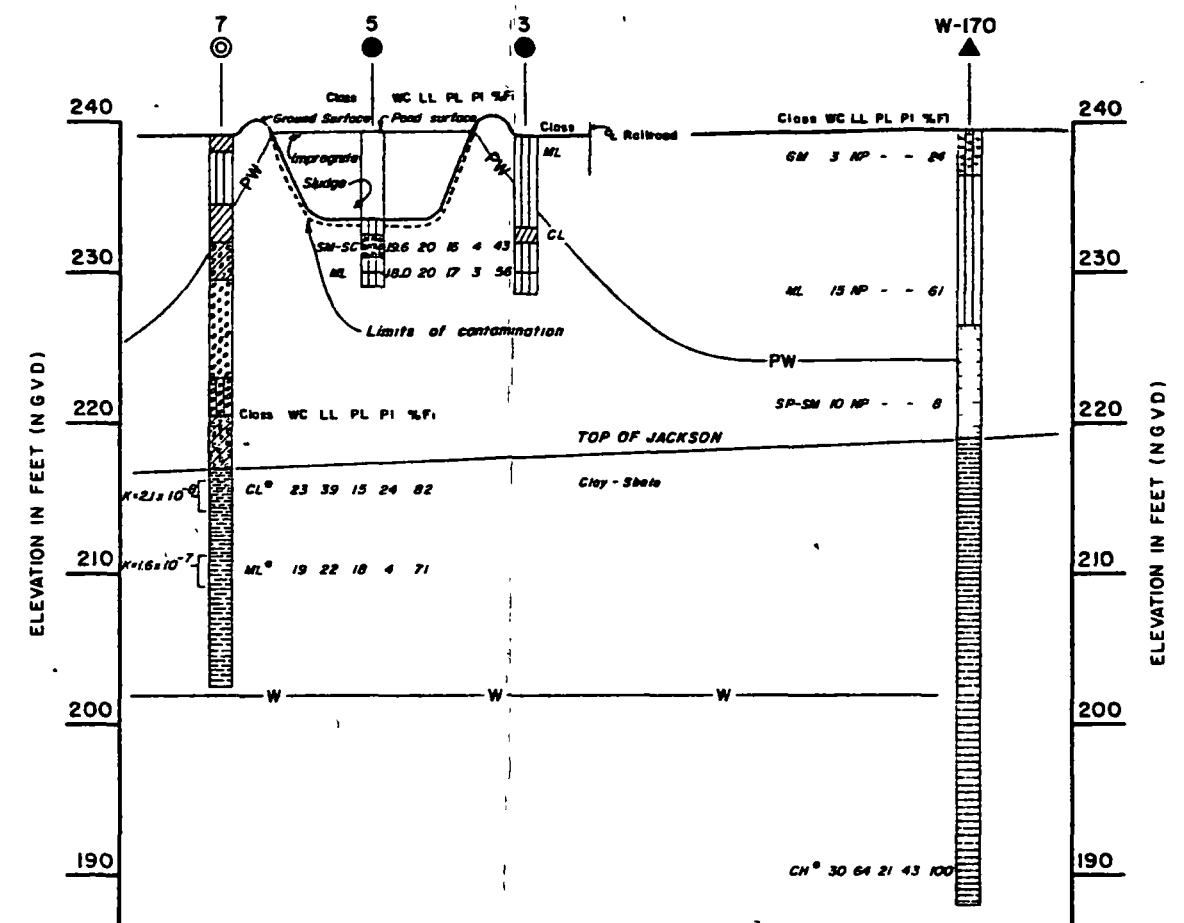
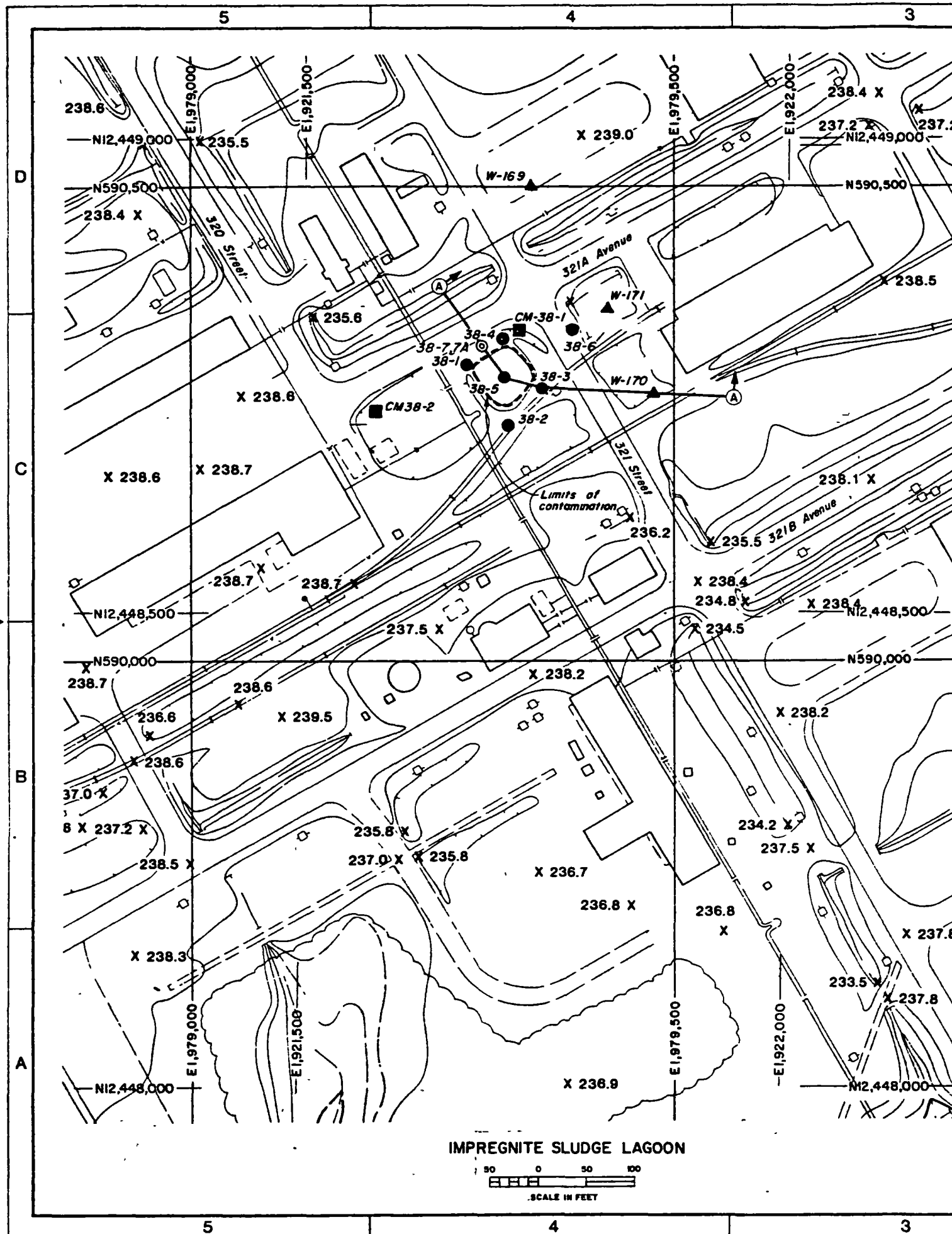








DRAWINGS



SITE 38 - GEOLOGIC SECTION A-A





### LEGEND

- ◎ DENISON HOLE WITH COMPANION AUGER HOLE  
 ● AUGER HOLE  
 ▲ MONITORING WELL  
 ■ CONTROL MONUMENT  
 ■ SOIL CLASSIFICATION PERFORMED ON CLAY-SHALE  
 -W- WATER TABLE  
 -PW- PERCHED WATER  
 ----- LIMITS OF CONTAMINATION

- 
- IMPREGNITE SLUDGE
- CL, LOW PLASTICITY CLAY
- CH, HIGH PLASTICITY CLAY
- SC, CLAYEY SAND
- ML, CL-ML, SILT, CLAYEY SILT
- SM, SILTY SAND
- SP, SAND
- CLAY-SHALE
- GM, SILTY GRAVEL

- |       |                                    |
|-------|------------------------------------|
| Class | UNIFIED SOIL CLASSIFICATION SYSTEM |
| WC    | WATER CONTENT                      |
| LL    | LIQUID LIMIT                       |
| PL    | PLASTIC LIMIT                      |
| PI    | PLASTICITY INDEX                   |
| %F1   | PERCENT FINES                      |

$K = 2.1 \times 10^{-8}$  { PERMEABILITY,  
CM/SEC, FROM LAB  
TEST ON SAMPLE  
FROM ZONE  
INDICATED

Revisions									
Synbol	Description					Date	Approved		
	<b>U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA</b>								
Designed by	<b>PINE BLUFF ARSENAL PINE BLUFF, ARKANSAS PR: 63 FY: 66 HAZARDOUS LANDFILL/CLOSURE SITES SITE 38 PLAN OF EXPLORATION &amp; SECTION</b>								
Drawn by									
Checked by									
Submitted by	Scale	A5 Shows	Sheet reference number	Revision No. DACA 56- -B Contract No. DACA 56- -C Sheet of					
Chart	Date	Dwg Code							